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MONSTER SEA-SERPENTS.*

By Richard A. Proctor.

I HAVE been gratified and rather amused to find a short article, which I contributed more than a year since to *The Newcastle Weekly Chronicle* on the subject of a marine monster seen near Panama, appearing in the very valuable report of Professor Spencer F. Baird, United States Commissioner of Fish and Fisheries. A genial article in *The Tribune* for January 4 presents my recognition of this marine monster and defence of the sea-serpent as a tardy admission on the part of science that there may be more things in sea and land than had been dreamt of in an unphilosophical philosophy. But so far as I am concerned there has been no "ridicule, followed by denial, then by doubt, and lastly by partial acceptance." I have always been a believer in the sea-serpent of Capt. McQuhae, of the *Dædalus*. I was a very young lad when his report of the strange encounter first appeared; but it seemed to me then, and it seems to me still, that the sea captain had much the best of the discussion with the representatives of science. There was that cautious naturalist and palæontologist, Richard Owen, so anxious to disprove the sea-serpent that he pictured to himself the captain and officers of a British frigate frightened out of their wits, and out of one at least of their senses, by the sight of a sea-elephant (as he tried to make out) rather far away from its native abode, and urging its course as fast as possible homeward. Captain McQuhae, in a report to the Admiralty, says that he and his officers saw a long-necked sea monster travelling swiftly in the teeth of a ten-knot breeze on the surface of the sea, so quickly that he could see the waves frothing against the creature's chest. It passed so near that he could have distinctly seen the features of a man at the distance. He and his officers had a good view of the creature. (For a wonder, they were not possessed by the customary desire to shoot it, a desire which speaks as honourably of the human race as the saying of the North Country miner immortalised by Leech, who, seeing a stranger, thought it due welcome to "'eave 'arf a brick at un.") They rejected the sea-elephant with derision, as entirely inconsistent with what they had clearly seen; while the idea of their being frightened—well, Americans in old times tackled a few of our British frigates with greater or less success, but they did not find our seamen quite so timorous as to be likely to tremble in their shoes at the sight even of an extra large sea-elephant. Yet Prof. Owen persisted in his belief that the *Dædalus* sea-serpent story was not worthier of credence than a story about ghosts. That particular ghost he thought he had laid.

Since then all sorts of explanations of sea-serpent stories have been advanced. Because one captain has mistaken a lot of floating sea-wreck half a mile away for a sea monster, therefore the story of a sea creature seen swiftly advancing against wind and sea, at a distance of less than 200 yards, meant nothing more than misunderstood sea-weed. Another mistakes a flight of birds in the distance, or a shoal of porpoises, or even a range of hills beyond the horizon, for some sea-sepentine monster, and forthwith other accounts, however manifestly inconsistent with such explanations, are regarded as explained away. Then, worst of all, some idiot invents a sea-serpent to beguile his time and find occupation for his shallow pate, and so soon as the story is shown to be only a story, men of sense and standing, as incapable of the idiocy of inventing sea-monsters as I am of inventing a planet, are supposed to have amused their leisure by sending grave reports of non-existent sea-monsters to men under whom they (the seamen, not the sea-monsters) held office, or by taking oath before magistrates that they had seen sea creatures which they had invented, and by parallel absurdities.

All this has been done in the case of the sea-serpent, as something akin to it was long since done in the case of the cameleopard, and later in the case of the gorilla. Much earlier Herodotus had been called the Father of Lies instead of the Father of History, because of wonders related by him which have since been shown to be facts. The poor (in intellect and veracity) are always with us; and they can never admit that anything exists outside what they know, or understand how any traveller in little known regions can fail to lie lustily when he comes home again. Among the creatures thus specially ridiculed the monster earth-worm described by Rapp, some forty years ago, was specially ridiculed, and those who believed in it, or declined utterly to reject it, were sneered at just as those who recognise the reasonableness of the sea-serpent are laughed at now. Rapp said he had seen in South Africa a monstrous earthworm, several feet in length. One of these he described as 6 ft. 2 in. long, and proportionately thick. The measurement was regarded as not worthier of credence than Gulliver's precise statements of the height of Lilliputian and Brobdingnagian animals. The absurdity and impossibility of the thing was abundantly proved. A worm of the ordinary kind averages, let us say, 6 in. in length. Here, if this lying traveller was to be believed, was an animal more than twelve times as long, and therefore some 1,800 times as large. Now, the ordinary boa-constrictor is about eighteen feet long. Multiply his length by twelve, and we get a serpent of 216 feet in length. *Credat judæus*, &c. Rapp was demonstrably a vendor of lies—so, at least, said the young buccaneers of the Press. Well, there is now in the Zoological Gardens in London a living specimen of the species described by Rapp. It is not one of the largest. Indeed, these creatures are hard to catch and keep alive; and probably the biggest are the most difficult to secure. They are described as "fairly abundant in the neighbourhood of Port Elizabeth and other parts of Cape Colony," but they keep out of sight unless heavy rains drive them out of their holes, when hundreds of them can be seen crawling about, but

* From the *New York Tribune*.

XUM

they usually perish soon after thus visiting the surface. The specimen at the Zoological Gardens is about five feet long, however, so that it is quite a good-sized worm. Here, then, is a case where a creature, the description of which excited as much ridicule as that of the sea-serpent, is found not only to exist in large numbers, but to be amenable to the customary treatment extended by our kindly race to the inferior races: we have captured a specimen and keep it on show.

Yet those who formerly laughed at the earthworm laugh now about the fancied sea-serpent. They laugh so consumedly, and make so much noise over it—the laughter of such folk being "as the crackling of thorns under a pot"—that, as my friend Mr. W. Mattieu Williams points out, and as I can confirm, "much valuable evidence concerning the sea-serpent is suppressed by the flippant sneering of the class of writers who require no other qualification than ignorance of the subject on which they write. Scores, perhaps hundreds, of trustworthy mariners of all ranks, in both the naval and mercantile services, have seen what they believe to be such a creature, but they refuse to publish any account of their observations, knowing they will be insulted, and publicly gibbeted as fools and liars if they do."

The foolish laughed in the same way over the kraken, as you point out, and the monster they rejected as impossible has been killed and measured. Whether the sea-serpent, or any creature whose prey is chiefly sought at a considerable distance below the surface, will ever be captured or killed is very doubtful. But their existence ought never to have been regarded as doubtful after the evidence gathered in Massachusetts in 1817, and the report of the captain of the *Dædalus*. There are probably several varieties of sea-creatures which look like serpents, and among these varieties some may quite probably be really serpentine. But some of the supposed sea-serpents must have really propelled themselves otherwise than as serpentine sea-creatures do. For they moved rapidly along the surface without perceptible undulations, and nothing but concealed paddles could have urged them on in this way. In my article on "Strange Sea-Creatures," which appeared eleven years ago in *The Gentleman's Magazine*, several singular inhabitants of the sea—and in particular a monstrous skate seen in the East Indies—are described, and evidence given to show that even among comparatively familiar species new varieties are from time to time being discovered. Thus, though no sea-serpent so large as the Sea Orm or Sea Worm, described by Bishop Pontoppidan as six hundred feet in length, have as yet been seen, it does not follow that none such exist, albeit, I cannot doubt that the good Bishop's accounts are very largely exaggerated. He was not quite so foolish as the modern critic, who, though he perhaps has never left his native town, undertakes to contradict men who describe what they have seen. But I fear he erred as far in the opposite direction. The boa constrictor and the condor have been described in such terms by comparatively modern travellers (as Humboldt has shown) as would suggest creatures akin to the serpent which went for Sindbad, and the roc which also adorns Sindbad's narrative and appears elsewhere in tales of the East. But to exaggerate is one thing, to invent is another. The man who is foolish enough to lie about his travelling experiences is not capable of inventing a new animal worth five minutes' consideration; but, on the other hand, the man who, being sensible, is honest and truthful, is yet very apt to err in the way of unintentional exaggeration. I think poor Capt. Drevar's narrative of a long-necked sea monster which captured in its folds and took down a sperm whale was a little exaggerated, though he and his mates swore to the truth of the story before a magistrate, and he himself was most unfairly punished by his employers for telling what he had seen—he was, in fact, ruined for life. ("I would not tell about it," said an old salt to Capt. Drevar, "if I saw five hundred sea-sarpints.") But I no more believe that these men would have invented such an animal if they could, or could have invented it if they would, than I believe that an utterly ignorant man could have devised the famous Lunar Hoax—the clever story respecting a powerful telescope showing living creatures in the moon. Yet that story did not, as was alleged, take in Arago; no one acquainted with optical laws could have been deceived by it for an instant. To imagine that sailors could accomplish the far more difficult feat of inventing a new kind of animal, without immediately exposing their ignorance to every one acquainted with the laws of comparative anatomy, is to imagine the impossible.

THE PHILOSOPHY OF CLOTHING.

By W. Mattieu Williams.

V.—THE COOLING ACTION OF THE SKIN.

In my last I suggested that the carbonic acid which is evolved from the surface of the skin may be a product of internal combination of solid or liquid oxygen with solid or liquid carbon. As this may appear paradoxical, I will discuss the question further.

That such combustion of these elements in a solid form may occur *internally*, *i.e.*, with exclusion of atmospheric air, we have many familiar examples. The case of gunpowder is one; gun-cotton, dynamite, and many other explosives are others. The source of the oxygen in gunpowder is the saltpetre, a compound of nitrogen, potassium, and oxygen, in which the chemical bonds that hold the oxygen to the nitrogen are so weak that a temperature of about 600° Fah., aided by "the predisposing affinity" of another substance ready to combine with oxygen is sufficient to effect the dissociation of the oxygen from the nitrogen. In gunpowder we have two such substances, sulphur and charcoal, both of which, when they combine with oxygen, produce gaseous compounds, the sudden expansion of which effects the explosion. Gun-cotton and dynamite are similar. In these we have hydro-carbons—such as cellulose and glycerine—that have been so treated with nitric acid that we have the loosely-held compound of nitrogen and oxygen still more intimately associated with the hydro-carbon, and still more easily dissociated with similar result.

We know that combustion (*i.e.*, combination of such combustibles as carbon and hydrogen with oxygen) is taking place throughout the body; but it is not explosive combustion, nor flaming combustion, but slow combustion, producing only the moderate temperature of "animal heat," and that the oxygen effecting this combustion is supplied by the lungs, with possibly some aid from the skin. If this combustion were local, if it took place at the lungs, where the oxygen of the air enters the body, the lungs should bear the same relation to the body as our fireplaces bear to the house; the lungs should be a centre of excessive heat, distributed from that centre.

But this is not the case. The lungs are not, as some teachers have said, "the fireplace of the body." Combustion is going on in the lungs, but no more so than in other parts, the temperature of the body being approximately equal throughout. I say "approximately," because there are variations, but these variations are not dependent upon proximity to the lungs, but to the work being done

on the spot. The head is hotter than the trunk when the muscles are reposing and the brain working hard, and so with other organs.

Oxygen enters the blood at the lungs, and carbonic acid leaves it there; but this does not prove that the particular carbonic acid that is expired at one moment is due to a combination of carbon with the particular oxygen of the immediately previous inspiration. It is far more probable—or I may say it is certain—that the dark venous blood is a carrier of the oxidised carbon produced by the general combustion taking place throughout the body, and that it gives out some of this as carbonic acid on reaching the lungs, and that it takes in some oxygen, becoming thereby arterial blood, the which red arterial blood carries round the oxygen to support the general bodily combustion.

The carbonic acid and the oxygen may be thus carried either mechanically or chemically; mechanically by being absorbed or occluded without combination, or chemically, by forming chemical compounds, carbonates, or oxides. In the case of the gunpowder above quoted, the oxygen is in chemical combination with its carrier; it forms an oxide of nitrogen. As an example of oxygen and carbonic acid being held mechanically by their carrier, I may cite the oxygen which exists dissolved or occluded, but not chemically combined, in water, the oxygen which is breathed by fishes, and the carbonic acid also contained in the water of springs, rivers, and the ocean. These are quite different from the oxygen that is chemically combined with the hydrogen to form the water. The latter can only be separated by chemical violence, but the mechanically dissolved or occluded oxygen and carbonic acid may be pumped out or driven out by boiling the water.

Magnus proved experimentally that blood is capable of absorbing a maximum of one and a-half times its own bulk of carbonic acid, and Magendie found that the venous blood he examined in its ordinary condition contained 78 per cent. of carbonic acid, and arterial blood only 66 (by volume).

I may here describe an experiment that I devised for displaying to a class at the Birmingham and Midland Institute many years ago, a visible illustration of the kind of action that takes place in the conversion of dark venous blood into bright red arterial blood by the action of oxygen. I first added to a solution of the protosulphate of iron (common green copperas) some carbonate of ammonia. This threw down a dark carbonate of iron of nearly the same shade as venous blood. Then to represent the lungs, I spread some of this slimy precipitate over white blotting-paper, and exposed it to the air. Oxygen was taken up, carbonic acid given off, and the dark carbonate of iron converted into blood-red sesqioxide. This experiment literally supplies some colourable support to the theory that the iron, which is a necessary constituent of the blood, is its oxygen and carbonic acid carrier.

My own view is that this change actually does occur in the blood, and I maintain this conclusion on the ground that, as a matter of chemical fact, any solution of iron or salt of iron exposed to the reducing agencies of the venous blood, and to its carbonic acid and carbonates, must be converted, as in my experiment, to a dark proto carbonate, and that such proto-carbonate exposed to the oxygen of the air, as is the venous blood in the lungs, must give off its carbonic acid, and become peroxidised and blood-red. I say that this action must occur, but do not say that it accounts for all the change. The total quantity of iron is insufficient for this, and there are other reasons that I must not further digress to state.

Let us now return from this bye-path to the highway of our argument. The detour was made in order to find an explanation of the cooling function of the skin where evaporation fails. It is found, accordingly, if some of the carbonic acid with which the blood in the capillaries is charged passes off as a gas by simple expansive evolution; for it cannot thus expand from the condensed to the gaseous form without absorbing or using up a large amount of heat or calorific energy, which heat it obtains from its surroundings, and thereby cools them.

I sit in a cold room and find that the previously-described extra vascular tissue of my left hand is purple. What must the blood in the superficial vessels have done to become thus abnormally venous? It must have parted with some of its arterial oxygen, and this must have combined with some combustible carbon, and in becoming venous, have helped to overcome the cooling influence of the surroundings. If I now step into the hot chamber of a Turkish bath, the blood in these same vessels will become abnormally arterialised, brilliantly red; *i.e.*, it will give off some of its carbonic acid (by the cutaneous respiration already described), and thus co operate with the increased perspiration in performing the cooling function of the skin. The same occurs in the paler skin, but it is not so visibly displayed.

As I said at first, our artificial clothing should, as far as possible, assist our natural clothing, the skin, by continuing the same work that it performs; therefore we require for such clothing a material or materials that shall protect the body from the cooling influence of the outer air when it is colder than our bodies; that shall have a cooling, or at least a protecting influence, when we are exposed to higher temperatures than blood-heat, and that shall also allow free transpiration of gases and vapours.

This last condition at once excludes all non-porous material. The armour of our forefathers was detestable clothing, and I am told that our Life Guardsmen would rather go into action bare-breasted than with their breast-plates—would prefer exposure to sword and bullet to the depressing burden of such breast-protection. Waterproof garments that are likewise air-proof are similarly evil. When I reach this part of the subject I shall point out the distinction between waterproof and water-repellant material, which latter need not resist the passage of the gaseous exhalations of the body.

We are thus presented with a somewhat paradoxical problem. We must find a material that will allow free diffusion of gas or vapour, but will resist the passage of heat, that will shut in the subtle, imponderable, penetrating radiations that travel with the inconceivable velocity of light, and yet shall permit the slow, creeping diffusion of aqueous vapour, carbonic acid, &c., of such extreme comparative grossness.

We all know well enough how this is practically done; but the philosophy of the doing is by no means generally understood.

PHOTOGRAPHY AND MEDICAL JURISPRUDENCE.

By William Mathew.

THE DETERMINATION OF PERSONAL IDENTITY.

IN all books dealing methodically with the topic of medical jurisprudence, attention is directed to that division of the subject which treats of legal identification and its related particulars. The rules and usages by which the procedure is governed are primitive, but of long antiquity.

Whether before the accredited officer of the Crown—the county coroner—or before the courts of criminal law, the

corporeal presence of the individual touching whom the inquiry is on foot is an indispensable preliminary. "If the body be not found, the coroner cannot sit," says Blackstone. "An inspection of the body is the essence of the inquiry," observes Dr. Taylor, in "Principles of Medical Jurisprudence."

Upon occasion, in the Courts of Civil Procedure also, the question of identity becomes the essential feature of the investigation. It is the real issue submitted to the adjudicators. In such instances, says Dr. Beck, "the whole evidence turns on the question of identity."

Stature, temperament, marks upon the person, colour of the hair, colour of the eyes, general resemblance. These have heretofore been the ordinary elements of the physiological sort upon which a conclusion has been based.

When and where photographic portraiture was first introduced to the notice of the Courts, does not clearly appear. Certainly, it has not been received with undeviating reliance, for the photographic presentment in many instances differs very materially to the eye from the personal reality. Witnesses, upon their oath, have sometimes been requested to pronounce upon resemblances from which, under ordinary conditions, they would have shrunk in bewildered uncertainty.

Yet, when considered from the standpoint (1) of their perfect accuracy of delineation; (2) of their minutely-true reproduction of the proportionate areas occupied by the several features; and (3) of the apparent permanence, in adult life, of those proportionate areas, there would certainly appear to be no inscrutable reason why photographs might not be subjected to tests of a severely scientific nature.

There are three or four indispensable conditions to be accepted by scientists, preliminary to such a consummation.

I. A due recognition of the permanence of the essential particulars of a given face.

II. Of the greater or less divergence of all other faces whatsoever from the permanent particulars of the face in question.

III. The requisite reliability of a unit of admeasurement that shall be, similary, (1) permanent in a given face; (2) discrepant, more or less, in all other faces.

IV. The accredited presence of a sufficiently undeviating horizontal plane to afford an available zero or datum line.

Now, in order to sustain the proposition that a given adult face is permanent in its chief particulars, it needs but the obvious reflections—(1) That when a man stops growing, the bones of his face stop growing at the same time as all the rest; (2) that when the bones of the face cease growing, the several features thenceforward retain in permanence their original *locus in quo*.

It should go without saying that the requisite unit of the admeasurement must necessarily be sought for in the face itself; for by this expedient the varying magnitudes of photographic portraits are effectually legislated for. Hence the adaptability of the coloured circle of the eye for the desired purpose. It is (1) well-defined at its exterior circumference; it is (2) a permanent quantity in a given individual; (3) its dimensions so materially differ in different persons that of itself it becomes an important factor of diversity between photographs that are inherently discrepant.

Granted, then, the requisite permanence of the facial perpendicular, and the requisite permanence of the unit of the admeasurement (the diameter of the iris at its exterior rim), it remains but to consider the limitless amplification of the facial diversity.

It has been long an accepted hypothesis that the dimensions of an ideally-perfect face should consist of certain duplicate and triplicate repetitions of its own elements; yet, nevertheless, that all actual faces are, to a greater or less extent, departures from the given ideal. In strict conformity with this hypothesis, it may be pointed out that the endlessly numerous permutations which are everywhere consequent upon the presence of even a few factors of diversity, is a matter quite amenable to arithmetic proof. This principle of permutation finds its always-familiar illustrations in the "ringing of changes" upon an octave of bells, in the casting of dice, and in the myriads of differing verbal forms that a few vocal articulations have afforded to all the nations of the earth.

In conclusion. The general and special data which have been here set forth, appeal in the first instance to the common apprehension of all persons of intelligence; and, secondarily, to the tests and investigations of experts. As the result of such tests and investigations, it is now confidently maintained that the data and conditions enumerated are trustworthy and open to proof. The photographic portraits of various public personages, taken after intervals of twenty or more years, and suitably enlarged, have been found to correspond very minutely in admeasurement, whilst, in the meanwhile, great external change has been going forward in their countenances. On the other hand, a comparison of the portraits of any two distinct individuals, tested under the same rigid conditions, fully justifies the statement that, in such cases, varied and palpable discrepancies will inevitably become manifest.

The physiological facts having been accepted, the formularies of procedure may suitably engage attention. To those to whom the topic is new, an explicit statement of details might prove the more convenient; but summarily and technically those particulars may be dealt with as follows:

1. Upon a photograph of enlarged magnitude let a right line be drawn from centre to centre of each pupil. 2. From the given centres, describe arcs intersecting each other, above and below the right line, of a radius as the distance between the centres. 3. From the points where the arcs cut each other, produce the perpendicular. This will, necessarily, be the true facial perpendicular, whatever may be the *pose* of the sitter. 4. Lay off a parallel on either side of the perpendicular, at the distance of the given centres. 5. Lay off a series of parallels, above and below the line of the pupils, and let their measured distance apart be that of *precisely the diameter of the iris*. 6. Let each parallel extend over the right-hand margin of the portrait, and be numbered consecutively. The given line of the pupils being a nought, or zero, let the other numbers proceed from it, upward and downward. 7. Reproduce these details upon the second portrait, and thereupon proceed to make the necessary comparison of particulars.

With the aid of the appliance known as the Identiscope, the required comparison can be effected under conditions the most favourable for careful inspection. Reproduced upon lantern-slides, conjoined by the agency of the zero-points, the compared portraits may be projected in combination, upon a scale of magnitude that would cause the most minute discrepancies to stand revealed in any reputed instances of spurious or doubtful identity.

The Forthcoming Exhibition of Photographs by Amateurs.—There is every prospect of this exhibition proving successful, as we understand that by far the greater proportion of the allotments in the spacious galleries where it is to be held have already been applied for by intending exhibitors. We have had an opportunity of inspecting the handsome and valuable medals offered as prizes by the London Stereoscopic Company, and should advise those amateurs who intend competing for them to send in particulars of their proposed exhibits without delay, as but little space is now available, and no pictures can be received for competition after the 14th inst. All information respecting details can be obtained on application at 108-110, Regent-street, W.

CHATS ON GEOMETRICAL MEASUREMENT.

By Richard A. Proctor.

(*Continued from page* 238.)

A. We still have to consider pyramids. I see, indeed, why you spoke of pyramids as the simplest elements into which plane-faced solids can be divided. Just as a rectilinear area has to be divided usually into triangles, before we can determine the rectangle to which it is equal, so a plane-faced solid would usually have to be divided into pyramids, before we can represent its volume by a parallelopiped.

M. Precisely. But we shall have very little trouble with pyramids now we have dealt with prisms. We must first show that triangular prisms on equal bases and of equal altitudes are equal:—

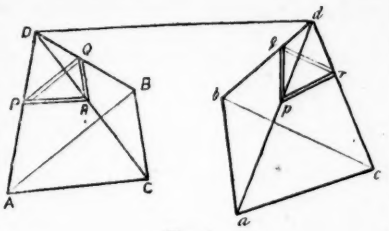

Fig. 4.

Let A B C D and *a b c d*, Fig 4, be pyramids on equal basis A B C, *a b c* (B and *b* remote) and of the same altitude, so that D *d* is parallel to the plane in which A B C *a b c* both lie. Take two planes close together, and both parallel to A B *c a*, cutting the pyramids in the thin triangular slices P Q R, *p q r*. These triangular slices are equal; for (by the laws of parallels)

$$\begin{aligned} PQR : ABC &:: (PR)^2 : (AC)^2 \\ &:: (DP)^2 : (DA)^2 \\ &:: (dp)^2 : (da)^2 \\ &:: (pr)^2 : (ac)^2 : pqr : abc. \end{aligned}$$

So that, as A B C = *a b c*, P Q R = *p q r*.

This being true of each such element of the two pyramids, we have finally, when their number is indefinitely large, the sum of all the triangular slices in one pyramid equal to the sum of all the triangular slices in the other, or, Pyramid A D B C = pyramid *a d b c*.

A. Of course, we can extend this result as we extended the first result obtained in the case of prisms.

M. Yes; obtaining finally the general result that pyramids on equal bases (of whatever number of sides, equal or unequal) and of equal altitudes are equal. Thus the volume of any pyramid can be represented by that of a pyramid on a triangular or rectangular base (as most convenient) and having one side perpendicular to the base.

A. What is the advantage of this?

M. It enables us to compare any pyramidal volume with the volume of either a right prism or a parallelopipedon, as we may prefer.

A. In whay way?

M. As follows:—

Let A B C *d* (Fig. 5) be a pyramid on the triangular base A B C, its altitude being *d* M (perp. to the plane A B C, and meeting that plane in M). Draw the lines A D, B E, C F at right angles to A B C, and let a plane through *d* parallel to A B C meet these lines in D, E, F. Join D E, E F, F D, completing the upright prism A E C.

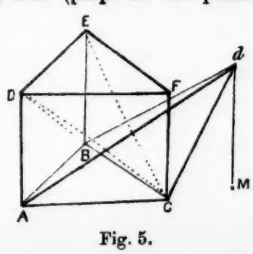

Fig. 5.

Now join D C, D B, completing the pyramid A D B C: this pyramid is equal to the pyramid A B C *d*, being on the same base and of the same altitude. Join E C, completing the pyramid D E F C: this pyramid is equal to the pyramid A B C *d*, being on an equal base D E F, and of the same altitude. But removing the pyramids A D B C, D E F C from the prism A E C, there remains only the pyramid E B C D, and this pyramid is equal to D E F C, since these two pyramids are on equal bases E B C, E C F, and (having a common vertex, D) are of the same altitude: therefore the pyramid E B C D is equal to the pyramid A B C *d*, which has been already shown to be equal to the pyramid E C F D. Thus

prism A E C = pyr. A D C B + pyr. D E F C + pyr. E B C D
= 3 pyramid A B C *d*

Wherefore, *A pyramid is equal in volume to one-third the prism on the same base and of the same altitude.*

A. This result, with what we have already learned, enables us, I see, to compare any pyramid with any prism or parallelopiped of the same altitude.

M. Yes; we have the general relation,—*A pyramid is equal in volume to one-third of a prism triangular, rectangular, quadrangular, or polygonal of the same altitude and having a base of equal area.*

A. How about cases where the altitudes are different?

M. Since the volumes of prisms and of parallelopipeds manifestly vary as the altitudes, so also must the volumes of pyramids, so that in fine we can compare the volume of any pyramid with the volume of any prism or parallelopiped.

A. If we wish to express the volumes of such solids numerically, how must we proceed?

M. We may say that the volume of a prism is the product of the base by the altitude, and the volume of a pyramid one-third the product of the base by the altitude, if we remember that this is only a convenient way of presenting certain numerical relations; for in reality we can no more multiply length by breadth to get an area, or an area by height to get a volume, than we can multiply miles by minutes. Yet just as the product of the number of miles by the number of minutes occupied in traversing each gives us the time (in minutes) occupied in making a given journey, so the product of the number of units of length in two adjacent sides of a rectangle gives us the number of units of surface in the rectangle. In like manner *The product of the number of units of surface in the base of a prism or parallelopiped by the number of units of length in its height, gives us the number of units of volume in the prism or parallelopiped;* while *One third the number of units of surface in the base of a pyramid by the number of units of length in its height, gives us the number of units of volume in the pyramid.*

(*To be continued.*)

ELECTRO-PLATING.

XVIII.

By W. Slingo.

THERE are many interesting features pertaining to the practical study of electricity, and amongst them the deposition of alloys certainly takes a prominent stand. Experiments in this direction will speedily disperse many of the ideas of students of electricity, not the least noticeable being that when a current traverses a solution containing two or more metals, it will precipitate only one of them. That this, however, is not necessarily the case may be easily demonstrated. What is really essential, if we wish to precipitate a single metal, is that the solution employed should be pure, and such that (based on experi-

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mental discoveries) only one metal is known to be deposited by it. For example, a solution of sulphate of copper would not dissolve and deposit zinc at the same time that it is so dealing with copper. On the other hand, a single metal may be deposited from a complex liquid by employing a current of suitable proportions.

If we take a number of electrolytic baths, each containing a different solution, and then divide the current from a battery of large cells between them, we should find, presuming the current to be powerful enough, that a different metal would be capable of being deposited in each cell—say, for example, copper, silver, iron, nickel—but the current that will decompose one solution so as to deposit its metal, will not necessarily act in a similar manner upon others. The current must be strong enough to overcome the most obdurate; and even then a difficulty will be experienced, as a larger proportion of the energy than is required will be expended on the more easily affected solution. Presuming, then, that such work is possible, there follows, as a natural consequence, the assumption that similar results would follow were solutions of the various metals collected in a single bath and the current suitably divided between anodes of those various metals, uniting again at the cathode. In this way the cathode would receive an alloyed deposit of the different metals. It is found that different metals, or the same metal in different solutions, necessitate the adoption of a varying number of battery cells. Thus copper is precipitated from its sulphate by a single cell, while other metals may require two, and some three, or even more. Suppose, then, for experimental purposes, we wished to precipitate a number of metals upon one and the same cathode simultaneously, we could do so by preparing a suitable solution of such metals and suspending from a rod of insulating material, or from separate insulated blocks, anodes of the different metals, and connecting to each anode the positive pole of its necessary battery, the whole of the negative poles being connected, directly or indirectly, to the cathode. A similar result might be accomplished by using a single battery comprising a number of cells sufficient to perform the most difficult precipitation, and then dividing the current between the various anodes, sufficient resistance being introduced between the battery and each anode to reduce the current between the cathode and the individual anodes to the requisite strength. Suppose, for example, that the electro-motive force required to be expended between anode A and the cathode to be three volts, and that between anode B and the cathode only one volt, then if resistance be introduced between the battery and B equal to twice that between B and the cathode, the electromotive force expended between the two latter points will be reduced to a third of what it is between A and the cathode, or of what it would be between B and the cathode were the resistance removed.

The plan more generally adopted, however, is to use an anode composed of the alloy similar to that which it is desired to deposit, and dissolving either a part of the alloy, or certain proportions of the separate metals composing it, in a suitable solution, and then using a current of sufficient intensity and electromotive force to produce a deposition of the more obstinate metal, the others being deposited with it. The danger is that the more easily-deposited metals will be precipitated to a greater extent than is desired, while the others share but little, if at all, in the deposition. That this would be so becomes very apparent on the briefest consideration. To take a more impressionable simile, we should scarcely expect that in a forest of young and of matured trees, a rush of wind capable of levelling the older trees, would not discriminate so impartially as to destroy an equal number of large and small trees, but would rather anticipate that it would expend itself upon a larger proportion of the weaker trees. Similarly, with a rush of elecrticity, there is the tendency, in the presence of two metals—say copper and zinc—to decompose more of the copper than of the zinc salts. This difficulty is a serious one. In the case of the forest, if we wished the destruction of an equal number of large and small trees, we should, in the absence of any other means, present fewer small than large trees to the wind. So in our bath, were no other course open, less copper than zinc would be allowed to be present.

The alloy most frequently deposited is that of zinc and copper—viz., brass. A useful and easily-made solution may be prepared in the following way:—Dissolve two ounces, or thereabouts, of good brass in four ounces of nitric acid, diluted with a small quantity of water. As dense red fumes of a very pungent and somewhat poisonous nature are evolved in this process, it is best carried on in the open air. If the acid is insufficient to dissolve the whole of the brass, a little more may be added, but care should be taken to avoid having an excess of acid—that is to say, more acid than would suffice to dissolve the metal; for this reason it is, perhaps, preferable to reject a small quantity of undissolved metal, rather than run the risk of having a superabundance of acid. In order to make sure that the whole of the acid has been neutralised by the metal, a gentle heat may be applied to the glass or earthenware vessel containing the solution. The absence of any further action indicates that there is no free acid present (presuming, of course, that there is at least a small quantity of brass in the solution undissolved). Next decant the solution into a large jug or other convenient receptacle, and add half-a-gallon of water. Then add slowly a solution of potassio-carbonate, consisting of half-a-pound of the carbonate to a pint and a half of water. Care is necessary in adding the carbonate, or the energy of the reaction may cause the loss of more or less of the brass solution. A precipitate of a light greenish colour is thus produced, and when it has settled the liquid is decanted and the precipitate well washed and subsequently dissolved in strong liquid ammonia, adding the latter gradually, stirring at the time, until the whole of the precipitate is again dissolved as a beautiful blue solution. A strong solution of cyanide of potassium is next added until the solution again becomes clear, when a small quantity of free cyanide must be added. Dilute this with sufficient water to make a gallon of solution, when it will be ready for the bath. The anode should be a sheet of brass of the same quality as that used in preparing the solution.

ORBIT OF THE SUN.

By R. A. Proctor.

ANOTHER subject about which many mistakes are made is that of the sun's motion in interstellar space. It is supposed by many that the sun has been shown to be travelling in an orbit around the star Alcyone, the chief of the Pleiades. Anything much farther from the truth can hardly be imagined. Absolutely nothing has been proved, or even rendered probable, about the sun's orbital motion through space, except that the sun's present course is directed towards the constellation Hercules. If it were certain that the sun is travelling in a nearly circular course around a centre, then of course it would follow that this centre lies in *some* direction at right angles to that towards

which the sun is travelling. If it were certain that the whole system of stars were circling around some centre, and if the Milky Way in reality represented the main body of a system of stars (strewn with tolerable uniformity throughout its extent) then it would follow that the centre motion lies somewhere in or near the Milky Way (as seen from the sun). Therefore it would follow that the central star, if there is any, must lie at or near one of those two parts of the Milky Way which lie at right angles to the direction in which the sun is travelling. This would bring us to the constellation Perseus on one side and to the constellation Scorpio on the other. It was reasoning thus, and because the remarkable star-group the Pleiades lay near Perseus, that Mädler arrived at the conclusion that the centre of the stellar system, around which all the stars revolve, may lie within the Pleiades and be—perhaps—Alcyone, the chief of that group. He noted further, that if there were a centre round which all the stars were travelling, then the velocities of motion would be less and less (not greater and greater, as in the solar system) the nearer the centre were approached, and so showed that the stars towards the centre ought all to seem to drift in one direction. He found that the stars round the Pleiades all *have* a general drift in one direction. Therefore, he concluded that *there* must be the centre of motion, presumably the very star Alcyone. And now let us see what is the real strength of this chain of reasoning. To be worth anything, every link of the chain should be sound. As a matter of fact, not a single link is worth anything. It is not only not certain that the sun is travelling on a nearly circular course, but almost certain that the sun cannot so travel. It is not certain that the whole system of suns is circling round a centre, but impossible that such a system can have a single centre of motion. It is not certain that the stars of the galaxy form the main body of a system of sun streams, as Sir W. Herschell originally supposed with tolerable uniformity throughout a single system, but it has been practically demonstrated that the stars of the Milky Way are arranged very differently from those in our neighbourhood, of which the sun is one. And, lastly, the one piece of positive evidence on which Mädler based his special conclusion has been shown to be altogether valueless, by the circumstance that precisely the same kind of star-drift which he recognised in the neighbourhood of the Pleiades exists in other regions—Gemini, Leo, Ursa Major, and elsewhere. Thus the whole chain of reasoning is found to be valueless. There remains not a thread of evidence in support of the idea that there is a central sun around which the whole universe of stars revolves.—*Newcastle Weekly Chronicle.*

FIRE WASTE.

MR. C. J. HEXAMER has been delivering a series of lectures before the Franklin Institute of Philadelphia on the fire waste of the country.

His lectures have received considerable attention, and the *Fireman's Journal* of New York, from whose columns the following is extracted, considers Mr. Hexamer's lectures full of practical suggestions. One of his lectures was on "Fires in Textile Mills," the special feature of it being on the construction of such mills with a view to fire prevention. The lecturer said that one of the most important precautions to be observed in erecting mills was to insure the confining of a fire to the apartment in which it originates. All stairways and elevators should be built in a shaft beside the building proper, the openings between them being shut off at the different floors by iron doors. The next precaution to be observed is in the construction of the floors. The best form of fire-proof floors is of brick arches built between iron girders placed at short distances. Floors of concrete or "terra-cotta lumber," a porous clay material that can be readily cut and shaped with edge tools, rank next in security. If ceilings are of wood, they may be covered with fine wire netting, and plastered over, or they may be rendered practically "fireproof" by coating with asbestos paint or by liberal and frequent applications of common lime whitewash. Additional loss is frequently caused by having floor-beams so deeply embedded in the side walls that when they burn through in the middle the weight upon them causes the overthrow of the walls when the floors fall in. This can be easily avoided by placing the joists so that they fall out when burned through in the middle. Fire doors are best made of heavy wood, covered on both sides with sheet-iron, and fastened to the brick wall. Two fruitful causes of fires in mills are the lighting and heating arrangements. Hot-water pipes are the safest, steam-pipes ranking next. To avoid having combustibles placed in contact with them, they should be suspended from the ceiling, where they are out of the way, and give the best heating results. Mr. Hexamer claimed for the incandescent electric light superiority over all other methods of illumination.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

XXI.—THE FRAMEWORK OF THE DWELLING-HOUSE.

STRUCTURAL EXAMPLES (*continued*).

THE DISPOSAL OF HOUSEHOLD REFUSE.

WE shall now pass on to the details of the hydraulic system of sewerage in so far as it bears upon the domestic drains and their accessories. To obtain security from sewer-gas has been the chief aim of modern sanitarians and inventors, and it has at length been recognised that, provided the channels for conveying away waste products are thoroughly sound and suitably placed, perfect immunity from foul air in the house will additionally depend upon (*a*) suitable disconnection of the house-drain from the public sewer; (*b*) relief of undue pressure upon traps by the establishment of an efficient system of ventilation, which shall provide for a constant supply of fresh air to the drain and all the pipes, and the constant removal of vitiated air therefrom at a place where it cannot affect the sanitary condition of the abode; (*c*) a sufficient, yet not too great, fall of the pipes, to ensure a speedy removal of their contents to the common sewer, aided, if necessary, by adequate flushing apparatus. As sewer-gas is not generated until decomposition sets in, and as decomposition of excrementitious waste does not commence until after several hours have passed, it follows that attention to the precepts last mentioned cannot fail to secure the desired result.

In a former chapter we noted that the chief cause of insecurity and leakage from the house-drain could be traced to its imperfect jointing. We condemned the use of clay for reasons which we gave somewhat fully. We are now inclined to condemn the use of even a good hydraulic cement, because it is open at all times to contraction and expansion, which, though but slight, is still sufficient to give rise to leakage; then again, cement is liable to give way during the settlement of the drain which may take place long after it has been carefully laid and tested. Although much can be done to prevent this settling of the drain by the preparation of a good foundation for it to rest

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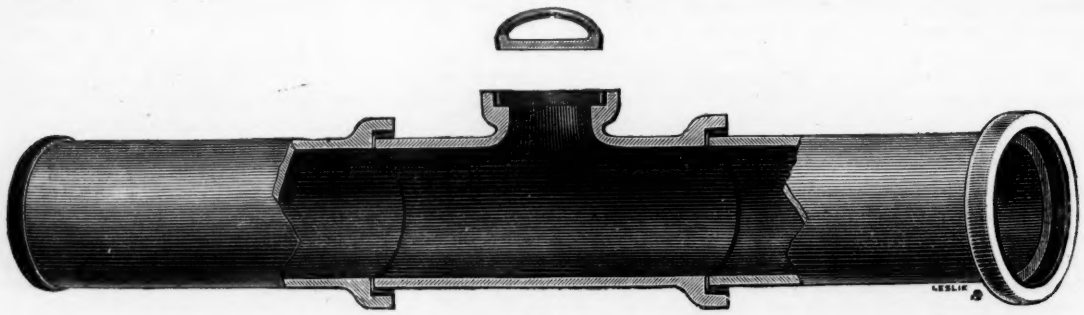


Fig. 16.

upon throughout its course, such as an encasement of concrete or brickwork, the expense of such a provision would, in most instances, be fatal to its adoption, so that in stoneware drains, which are to be preferred to iron pipes on account of their chemical constitution, a reliable water-tight and cheap joint must be looked upon as *sine quâ non*.

The chief difficulty to be surmounted consists in the accurate fitting of the spigot of one piece into the socket of the other, and as such a mechanically true fit cannot be secured in stone or earthenware-pipes, on account of the difficulty experienced in maintaining their forms during the process of firing in their manufacture, something else of a cheap, yet durable material, must be cast upon the ends of the pipes. This is carried out in the case of the "Stanford Patent Joint" for stoneware-pipes (Fig. 16). The casting upon the spigot fits into the casting within the socket in such a way as to make the joint quite watertight without the employment of any cement substance; all that is recommended for use is a little smearing of grease. Subsequent settlement of the drain only tends to make the joint more secure, and, what is of great importance, the drain can be laid by an ordinary unskilled labourer as soon as the trench for its reception has been made, whether it is wet and full of water or not. The material of the joint does not project within the pipe so as to cause any obstruction, and a junction with a water-tight stopper, as shown in Fig. 16, can be provided at intervals for purposes of inspection. All of these advantages are gained at a cost that does not exceed that for a cement-joint, and there can be no risk here from unskilled or dishonest labour. Stoneware pipes are, as a rule, seldom used for vertical work, or as soil-pipes; but, should it be deemed advisable to place them in such positions, the Stanford joint will undoubtedly be found to be the safest and best.

It has been said that there are not 500 houses in the whole metropolis which can claim to be thoroughly well drained; doubtless the fortunate half hundred are of the better class of expensive tenements. We may safely say, that although we have examined a very large number of dwellings in the suburbs, we have not yet discovered a single instance anywhere approaching the requirements of a modern healthy house as far as its drains are concerned, whilst artisans' dwellings everywhere are in a most insanitary condition. The reason of this is that the hydraulic system is a great deal too expensive to be carried out in its integrity for the poor; every cottage, or other building with only outhouse provision, ought not only to have its closet ventilated, but there ought to be one inspection chamber at least, and a good disconnecting trap with its accessories between the house-drain and the main-sewer or cesspool. As it is, there is either no sewer at all, or its place is taken by filthy, ill-constructed cesspools untrapped from the house, and polluting the ground of the neighbourhood with the pent up products of putrefaction.

We shall now describe some of the most approved forms of apparatus required for houses provided with water-closets on more than one floor, and which, therefore, necessitate soil-pipes, house-drains, yard-gullies, &c. Between the house-drain and the street-sewer there should intervene a disconnecting trap, with inlets for fresh air and an inspection arm to the drain below, or on the sewer side of the trap, which may or may not be continued into a ventilating or pressure-relieving shaft for the sewer. On no account ought the house-drain to be linked on to that of another abode. This defect obtains so often, that it has gained the distinctive title of "combined drainage system." Of the numerous examples that have hitherto been introduced into the market, the following are the most noteworthy:—

"Potts's Patent Edinburgh Air-Chambered Sewer and Soil-pipe Trap," Fig. 17, is virtually a well-glazed stoneware manhole divided into two air-chambers by a partition, the base of which forms a continuous down-sloping channel

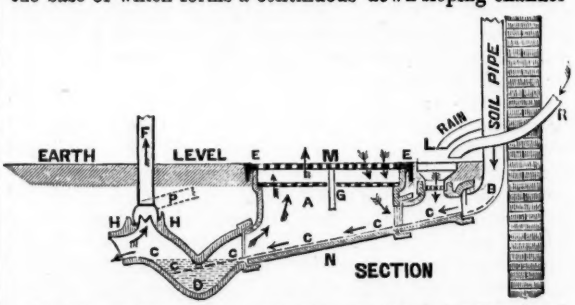


Fig. 17.—Sectional view of "Potts's Edinburgh Air-Chambered Sewer-Trap." A, air-chamber, 2 ft. 6 in. or 3 ft. long, divided by diaphragm, G, into two parts; this assists to direct the gas out of the first division of the chamber, A, and thus creates an air current through the trap. The soil passes down the pipe, B, into the channel, C C C, along the direction of the arrow-heads, and through the water seal of the dip-trap, D, into the sewer. The rain-water pipe L, and the household waste-water pipe, R, discharge into an open head-junction between the soil-pipe, B, and the air-chamber, A, and their contents thus aid in flushing the appliance. The air-chamber is covered by a grating, E, which is placed a little above the level of the ground, and when the trap is sunk too low to admit of this, the air-chamber must be provided with one or more raising pieces to bring it above ground. Below the grating provision is made for a disinfecting tray, to meet the desires of the fastidious. A pipe, F, which may be shifted to any position by a bend, as shown at P, is placed on the sewer side of the trap; it is 3 in. in diameter, and therefore quite sufficient to carry away superfluous sewer-gas. It is not always necessary, and the vent may be plugged and used as occasion requires for inspection on the sewer-side of the trap.

leading from the soil-pipe and other waste discharges into a shallow dip-trap on the house side of the street-sewer.

A reference to the figure will show that ample provision is made for the entry of fresh air into the contrivance, and for the separate reception of the contents of the soil-pipe, and household waste waters, all of which pass freely through the water valve into the sewer. The dip-trap is ventilated in addition on the sewer side by a pipe, which can be adjusted to the requirements of any house, to carry away the vitiated air, and to prevent undue pressure of sewer-gas upon the water seal. One or more soil-pipes may, if desired, open into the basal channel of the air-chamber.

To sum up, the Edinburgh trap is practically one of the best inventions of its kind, inasmuch as it provides for speedy removal of household waste, adequate ventilation of the drains, and perfect security from sewer-gas through efficient disconnection.

TRICYCLES IN 1885.

By John Browning.

(*Chairman of the London Tricycle Club.*)

SADDLES AND SEATS.

It would be difficult to over-estimate the value of a good saddle or seat on a tricycle, as on this depends the power of riding continuously for a number of hours healthfully and pleasurably.

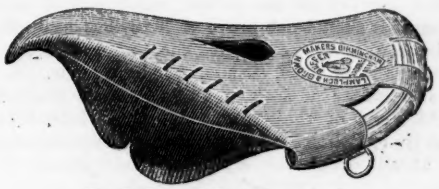
The Suspension Saddle.

We are indebted to the firm of Lamplugh & Brown, wholesale saddlers, for the best saddle for tricycles, known as the long-distance suspension saddle. This saddle consists of a single sheet of leather stretched on a triangular frame of thin sheet-iron or steel enamelled black, so formed that in the centre the leather is about an inch above the frame, and the rider is suspended on the leather just as he would be suspeded on parchment if he sat on a drum-head.

After riding on such a contrivance as I have described for some time, the combined effects of perspiration, of the action of the legs, and the weight of the rider, is to stretch the leather and cause it to sag down. So long as the leather does not touch the metal frame this is advantageous, as the seat of the rider is firmer and more comfortable; but after a time the leather touches the frame, and the rider rests on it. Under these conditions, riding on it becomes uncomfortable, and even dangerous. To obviate this difficulty a tension arrangement has been introduced, which, by means of a screw adjustment under the front of the saddle, admits of the leather being again stretched tighter on the frame, thus restoring the suspension, and with it the full advantage of the saddle.

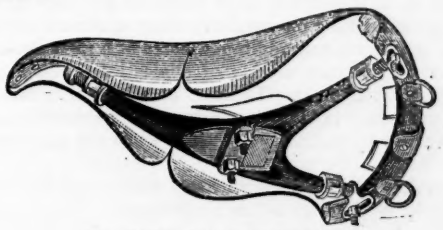
Having produced such a saddle as this, most makers would have been satisfied to have traded on their reputation. Not so Messrs. Lamplugh & Brown, for they have just brought out a new saddle for this season, which they have aptly named the Buffer-Saddle, in which the whole of the arrangements are greatly improved, and the insulation of the rider is carried to much greater perfection.

In this contrivance the triangular frame is tubular instead of flat, giving, without increase of weight, great additional strength. The tension is applied by means of three screw adjustments, one at each apex of the triangular frame. This allows the tension to be regulated to the greatest nicety. But the most important improvement, from which the saddle has been named is that, instead of the leather being attached at the back of the saddle to



The Buffer Saddle (upper view).

the upper part of the frame, thus resting on it, it is attached to the underneath of the frame; and on the top of the frame there is cemented a piece of cylindrical vulcanised rubber, about nine inches long, on which the leather rests. The peak of this new saddle is not turned up, as has hitherto been the case, but is turned down, as it should be.

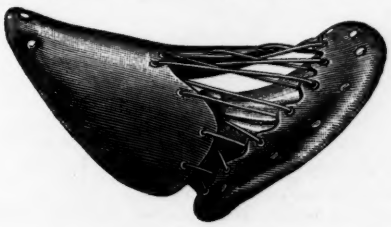


The Buffer Saddle (under view).

The effect of these new arrangements is very marked. While a new suspension saddle of the usual kind requires a few days' riding to make it comfortable, and some weeks, or even months, to get it into the best condition, the new saddle yields so to the figure of the rider that it gives a comfortable seat directly, and that with less unhealthy pressure than any other suspension saddle I have tried.

Some very taking stuffed saddles have been introduced, but though luxurious to sit on, they are, in my experience, none of them comfortable to ride on, the reason being that they cannot sufficiently provide for ventilation.

The best-ventilated saddle is Nagel's new laced saddle, which has only been introduced this season.



Nagel's Laced Saddle.

This is a suspension-saddle, in which the leather is in two parts, and the front and back portions are attached separately to the triangular frame. These two parts are united only by a very stout leather lace. The seat thus provided feels very comfortable, and though I should expect the lace to very soon become slack, nothing, of course, could well be easier than to draw the lacing tighter. Nagel's is a thoroughly useful saddle, and many riders of experience speak well of it.

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In a former article I have alluded to Leni's Anatomical Saddle, which is of sheet-steel, shaped exactly like an old sagged leather suspension saddle, but with all the parts sunk that could by any possibility exert any injurious pressure upon the rider.

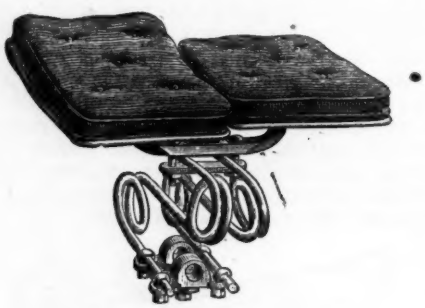
I have no experience of this saddle, which is scarcely yet ready for delivery to the public, but I should consider that, even if it should not prove a luxurious seat, it will certainly be a fairly comfortable one, and the safest, from a hygienic point of view, that has yet been made.

This is a matter of such great importance that, after I have ridden one of these new saddles, as I intend to do, for some time, I shall give a report of my experience, if the results at all equal the sanguine anticipations of the inventor.

Whatever leather saddle I ride, I always keep it well dressed with vaseline or Prout's dubbin. Either of these protects the leather from drying and cracking in summer or becoming mildewed by damp in the winter. The dressing also prevents the rider from shifting about on the saddle when riding, and, if the machine should be out in a shower of rain, the leather will absorb but very little moisture.

There is unfortunately a prejudice on the part of most ladies against riding on saddles. They confound riding a tricycle saddle with straddling a horse as a man does. In fact, you do not ride astride of a small tricycle saddle; you simply sit upon it. The seat of a lady on a saddle is firmer, the action in riding is easier, and the dress is much less disturbed by pedalling than it is when she rides upon a seat.

Something may be done with a tricycle seat by shaping it similarly to the seat of an old-fashioned Windsor chair. But even the best shaped seat prevents the rider from sitting nearly over his pedals, and thus pedalling with a vertical action, or, if he sits over, will chafe him most uncomfortably, and deprive him of a great deal of his power.



Bale's Divided Seat.

Those who cannot, or will not, ride on a saddle should try Bale's divided seat, which is made by the Coventry Machinists Company.

This seat is made of sheet-iron in two portions, as shown in the engraving. Each half rocks on a separate hinge, which is placed underneath the seat. As one leg falls and the other rises each half of the seat gives alternately, so that the rider can place full power on his pedals without any resistance on the edge of the seat; so that all chafing is prevented, and as the two halves of the seat are so arranged that there is a clear space of nearly an inch between them all injurious pressure when riding is completely avoided. This is undoubtedly the most perfect seat, physiologically speaking, that has been contrived. This seat is furnished with two small cushions, stuffed with horsehair and covered with a strong rep. I should prefer rather thinner cushions for my own riding, covered with leather.

My first sensation when riding on this seat was a feeling of insecurity produced by the seat moving under me; but after I had been working on it a few minutes, I found that I could leave go of my handles and pedal fast, so that with those who like a seat, or are apprehensive of any ill effects from riding on a saddle, I should think that Bale's divided seat will be a great favourite.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

BY MONS. DE FONTENELLE.

WITH NOTES BY RICHARD A. PROCTOR.

THE FIFTH EVENING.

(*Continued from p. 235.*)

"I DO not ask you," said the Marchioness, "whether in those worlds of the Milky Way there be any moons. I see they would be of no use to those principal planets which have no night, and move in spaces too straight and narrow to cumber themselves with the baggage of inferior planets: yet pray take notice, that by your liberal multiplication of worlds, you have started an objection not easily answer'd. The vortexes whose suns we see touch the vortex in which we are; and if it be true that vortexes are round, how then can so many bowls or globes all touch one single one? I would fain know how this may be done, but cannot well reconcile it."

"You show a great deal of wit, madam," said I, "in raising this doubt, and likewise in not being able to resolve it; for in itself the thing is extremely difficult, and in the manner you conceive it, no answer can be given to it; and he must be a fool who goes about to find answers to objections which are unanswerable.* If our vortex had the form of a dye, it would have six squares or flat faces, and would be far from being round; and upon every one of these squares might be plac'd a vortex of the same figure; but if instead of these six square faces, it had 20, 50, or 1,000, then might 1,000 vortexes be plac'd upon it, one upon every flat: and you know very well, that the more flat faces any body hath on its outside, the nearer it approacheth to roundness; just as a diamond cut facewise on every side, if the faces be very many and little, it will look as round as a pearl of the same bigness. 'Tis in this manner that the vortexes are round; they have an infinite number of faces on their outside, and every one of 'em has upon it another vortex: these faces are not all equal and alike; but here, some are greater, and there, some less: the least faces of our vortex, for example, answer to the Milky-way, and sustain all those little worlds. When two vortexes are supported by the two next flats on which they stand, if they leave beneath any void space between them, as it must often happen, Nature, who is an excellent housewife, and suffers nothing to be useless, presently fills up this void space with a little vortex or two, perhaps with a thousand, which never incommode the others, and become one, two, or a thousand worlds more; so that there may be many more worlds than our vortex has flat faces to bear 'em. I will lay a good wager that tho' these little worlds were made only to be thrown into the corners of the universe, which otherwise would have been void and useless, and tho' they are unknown to other worlds which they

* Especially when these objections arise out of theories which are neither demonstrated nor demonstrable.—R. P.

touch, yet they are well satisfy'd with their being where they are. These are the little worlds whose suns are not to be discovered but with a telescope, and whose number is prodigious. To conclude, all these vortexes are join'd to one another in so admirable a manner that every one turns round about his sun without changing place; every one has such a turn as is most easy and agreeable to its own situation; they take hold of one another like the wheels of a watch, and mutually help one another's motion, and yet 'tis certain that they act contrary to one another. Every world, as some say, is like a football made of a bladder covered with leather, which sometimes swells of its own accord, and would extend itself if it were not hinder'd. But this swelling world being press'd by the next to it, returns to its first figure, then swells again, and is again depressed; and some affirm that the reason why the fixed stars give a twinkling and trembling light, and sometimes seem not to shine at all, is because their vortexes perpetually push and press our vortex, and ours again continually repulses theirs."*

"I am in love with these fancies," said the Marchioness; "I am pleas'd with these footballs, which swell every moment, and sink again, and with these worlds, which are continually striving and pushing one another; but above all, I am pleas'd to see how this justling keeps up the trade of light, which is certainly the only correspondence that is between them."

"No, no, madam," said I; "light is not their sole commerce. The neighbouring worlds sometimes pay visits to us, and that in a very magnificent and splendid manner. There come comets to us from thence, adorn'd with bright shining hair, venerable beards, or majestic tails."

"These," said she, "are ambassadors whose visits may be well spared, since they serve only to affright us."

"They scare only children," said I, "with their extraordinary train; but, indeed, the number of such children is now-a-days very great. Comets are nothing but planets, which belong to a neighbouring vortex, they move towards the outside of it; but perhaps this vortex being differently press'd by those vortexes which encompass it, 'tis rounder above than it is below, and it is the lower part that is still towards us.† These planets which have begun to move in a circle above, are aware that below their vortex will fail 'em, because it is as it were broken: Therefore, to continue the circular motion, it is necessary that they enter into another vortex, which we will suppose is ours, and that they cut through the outsides of it. They appear to us very high, and are much higher than Saturn; and according to our system, it is absolutely necessary they should be so high, for reasons that signify nothing to our present subject. From Saturn downwards to the other side of our vortex, there is a great void space without any planets. Our adversaries often ask us, to what purpose this void space serves? But let them not trouble themselves any more; I have found a use for it: 'Tis the apartment of those strange planets, which come into our world."

"I understand you," says she; "we do not suffer them to come into the heart of our vortex, among our own planets, but we receive them as the Grand Signior does the ambassadors that are sent to him; he will not show them so much respect, as to let 'em lodge in Constantinople, but quarters 'em in one of the suburbs of the city."

"Madam," said I, "we and the Ottomans agree likewise in this, that as they receive ambassadors, but never send any, so we never send any of our planets into the worlds that are next us."

"By this," says she, "it appears, that we are very proud; however, I do not yet very well know what I am to believe. These foreign planets, with their tails and their beards, have a terrible countenance, it may be they are sent to affront us; but ours that are of another make, if they should get into other worlds, are not so proper to make people afraid."

"Their beards and their tails, Madam," said I, "are not real, they are phænomena, and but mere appearances. These foreign planets differ in nothing from ours; but entring into our vortex, they seem to us to have tails or beards, by a certain sort of illumination which they receive from the sun, and which has not been yet well explain'd.* But certain it is, that 'tis but a kind of illumination; and, when I am able, I will tell you how 'tis done."†

"I wish, then," says she, "that our Saturn would go take a tail and a beard in another vortex, and affright all the inhabitants of it. That done, I would have him come back again, leaving his terrible accoutrements behind him, and, taking his usual place amongst our other planets, fall to his ordinary business."

"'Tis better for him," said I, "not to go out of our vortex. I have told you how rude and violent the shock is when two vortexes jostle one another; a poor planet must needs be terribly shaken, and its inhabitants in no better condition. We think ourselves very unhappy when a comet appears; but 'tis the comet that is in an ill case."

"I do not believe that," says she; "it brings all its inhabitants with it in very good health. There can be nothing so diverting as to change vortexes. We that never go out of our own sphere lead but a dull life. If the inhabitants of a comet had but the wit to foresee the time when they are to come into our world, they who had already made the voyage would tell their neighbours beforehand what they would see; they would tell them that they would discover a planet with a great ring about it, meaning our Saturn; they would also say, you shall see another planet which has four little ones to wait on it; and perhaps some of them, resolved to observe the very moment of their entrance into our world, would presently cry out 'A new sun! a new sun!' as sailors use to cry, 'Land! land!'"

(To be continued.)

* The whole of this reasoning must be regarded as admirable fooling. Yet might it be paralleled with some disquisitions by mathematicians and physicists of our days—as any one who has read the "Unseen Universe" will admit.—R. P.

† Confidence is usually in an inverse ratio to knowledge. I have known comets and meteors as confidently dealt with by ignorant persons even in our own times, when men begin to know how little they know.—R. P.

The Colonial and Indian Exhibition.—The Royal Commission appointed for the purpose of organising this Exhibition, which is to be held in South Kensington next year, met for the first time on Monday at Marlborough House, under the presidency of the Prince of Wales, who expressed a hope that no untoward events may occur to prevent this resulting in perhaps the finest exhibition that has ever been held. The Guarantee Fund up to the present amounted to £128,600, and included the following sums:—The Government of India, £20,000; the Government of the Dominion of Canada, £10,000; the Government of New South Wales, £5,000; the Government of Victoria, £5,000; the Government of New Zealand, £5,000; the Government of South Australia, £2,000; the Government of Queensland, £2,000; and the Government of the Cape of Good Hope, £2,000.

* These doubts are unworthy of our confident philosopher.—R. P.

† Unfortunately, Fontenelle was never able to do this.—R. P.

SIMPLE METHODS OF MAKING LANTERN-SLIDES.

By W. Jerome Harrison, F.G.S.

THE optical lantern now holds a very high place as an article of scientific apparatus. In one or other of its forms it is to be found in almost every laboratory, while the itinerant lecturer would be badly off, indeed, without its aid. Moreover, in many homes the lantern is regularly used as a source of pleasure and instruction for the family circle. The extended use of the lantern has produced a corresponding improvement in the production of the slides by which its beautiful pictures are produced. The leading professional firms—York, Valentine, and others—now issue slides of the highest quality at exceedingly moderate prices. But it is the experience of every one who possesses a lantern that it is very frequently desirable to copy diagrams from books, or to exhibit tables containing figures, &c. Of course, such diagrams, &c., are frequently done on a large scale upon canvas or paper, with the aid of stencil-plates, but this is a far more laborious task than the preparation of a lantern-slide.

It is especially desirable, too, to exhibit pictures of what one has actually seen, during excursions in the field, or through the telescope or the microscope, and it is seldom, indeed, that slides of the exact places or objects can be purchased. Since the introduction of the "dry-plate" process into photography, the number of those who practise what now need *not* be the "black art" has immensely increased. Thousands of amateurs succeed in taking very good pictures indeed, and many of our scientific societies have distinct sections for the study of photography, consisting of members who devote themselves to special objects, such as the representation of famous trees, or the geological features of quarries, railway cuttings, &c.; or, it may be, to stellar photography. The "negatives" which are thus obtained will, it is true, yield a large number of "positive" prints, but, for the purpose of exhibition to an audience, transparencies made from the negatives and shown on the screen by means of a good lantern form by far the best mode of illustration.

The following notes include brief descriptions of simple methods of which I have availed myself at various times for the production of lantern-slides. For many of them I am indebted to the fertile mind of Mr. Woodbury, the introducer of the Sciopticon Lantern. I shall first speak of methods which do not require the aid of photography, and then pass on to the description of a photographic process which is rapidly coming into favour—the use of dry plates coated with gelatine, in which chloride of silver has been emulsified.

1. Tin-foil.—Take a piece of stout cardboard 3¼ in. square (the regulation "lantern-slide" size) and cut out a hole in the centre, larger or smaller according to the size of the diagram you wish to copy. Paste a piece of tin-foil over the hole. Now punch out in the tin-foil holes to represent the subject of the diagram. The cork-borers used by chemists are very useful for this purpose. If it is desired to represent the planets, small pieces of coloured gelatine (such as is contained in bon-bons) may be gummed over the hole in the tin-foil, and the characteristic features of the planet—as the belts of Jupiter—may be lightly sketched on the gelatine with Indian ink. For the illustration of double stars this method answers well. Nebulæ, too, can be shown by delicately pricking the tin-foil with the point of a needle. The needle-points for this class of work are made by forcing the eye end of a needle into the end of a wooden penholder: this is best effected with the aid of a pair of pincers or pliers.

2. Opaque Varnish on Glass.—For the representation of the radiant-points of meteor streams I have poured a pool of Bates' photographic black varnish upon a clear piece of glass. When the varnish is dry, or nearly dry, lines may be drawn through it with the point of a knife, or with a needle-point. These lines will be shown as white upon a black ground when thrown upon the screen by the lantern.

Smoked Glass. By moving a piece of clear glass for a minute or two over a candle-flame it will become coated with a dense deposit of carbon. Lines may be drawn through the black deposit with a fine steel point, and these lines, as in the last method, will be visible upon the screen as white streaks. The smoke from a small lump of burning camphor blackens the glass very quickly and thoroughly, and I prefer it to the candle. To prevent the black from getting rubbed off, strips of cardboard a quarter of an inch wide should be gummed round the margin of the slide (the black should be previously removed from the margin). Then a second piece of clear glass should be gummed or glued to the cardboard so as to cover over and protect the blackened surface. Very good effects can be produced upon glass surfaces treated in this way. I have effective diagrams of the electric spark taken between terminals at distances varying from one inch to two feet, physiological sections, &c. The varieties of clouds can be shown exceedingly well by using a *dabber* made by tying a bit of chamois leather over a wooden point, as the sharpened end of a penholder. By pressing the thumb upon the blackened glass, fine impressions of the furrows in the skin can be obtained, and it is very amusing to compare the thumbs of various individuals in this way—no two are exactly alike.

The methods so far described give white lines upon a black surface. The remaining non-photographic processes give black lines upon a white surface.

4. Clear Glass Coated with Gum Dammar.—It is not possible to work effectively upon clear glass with ink or pencil. The hard, smooth surface has no "tooth," as photographers say, and will not "take" the pigment. But it is possible to coat the glass with some transparent, colourless medium of a softer nature, on which lines may readily be drawn. For this purpose I use a solution of gum dammar in pure benzole—sixty grains to the ounce. The gum dissolves readily without the aid of heat, and the solution should be passed through filter-paper. The glass to be coated should be cleaned and slightly warmed. The varnish may then be poured on in a pool at one corner, and caused to run all over the plate, the excess being allowed to run off from another corner into the bottle again. Additional toughness may be given to the gum dammar by the addition of a few drops of a clear solution of india-rubber in benzole.

5. Ground Glass coated with Canada Balsam.—The surface of very finely-ground glass admits of drawings of great delicacy being made upon it by the aid of a sharp-pointed hard lead-pencil. When the drawing is completed, the glass should be warmed, and then coated with a mixture of Canada balsam and turpentine, about two or three ounces of the former to one ounce of the latter. The slide should then again be warmed, when the turpentine will be driven off by the heat, while the balsam will remain as a clear, hard, transparent coating, which fills up all the little hollows in the ground-glass, and makes it perfectly transparent. The Rev. W. H. Dallinger has employed this method with great success in the representation of microscopic organisms.

6. Gelatine, Mica, Talc.—A thin sheet of colourless gelatine, or of the minerals mica or talc, may have lines scratched upon it with a needle. The slide must then be rubbed over with lamp-black, which will lodge in the scratches and produce black lines when the slide is shown upon the screen. Sheets of colourless gelatine can be bought for this purpose, or they may be prepared by soaking the gelatine in cold water, then melting it by a gentle heat, and finally pouring the fluid upon a sheet of clear glass which has previously been rubbed with French chalk. When dry, the gelatine can readily be detached.

The last three methods are convenient for those who possess but little artistic ability, inasmuch as the transparent substances employed can be used like a child's transparent slate, the slide being placed over the diagram which it is desired to copy, and the lines traced upon it.

(To be continued.)

IS THE DIAMETER OF THE PUPIL OF THE EYE AN EQUIVALENT OF THE LIGHT'S INTENSITY?

By John Gorham, M.R.C.S. Eng.

(From a paper read before the Royal Society in November, 1884.)

IN this paper it is proposed to inquire whether the human eye is endowed with the power of measuring the varying intensities of light which fall upon the retina. To the physiologist who has investigated this confessedly most difficult department of optics such an inquiry will not be without interest, since the path in this direction is comparatively an unfrequented one. Little has yet been done, and that little, so far from strengthening our conviction as to the ability of the eye to indicate light of different intensities, has resolved itself into a deliberately announced persuasion that not only is this organ but little capable of judging of the relative strength of different illuminations, but that from its very nature and its incessant movements it is actually incapacitated for the task. See what a high authority says on the subject: (Sir John Herschel, Art. Light, Cyclop. Metrop.):—

We know of no instrument, no contrivance, as yet, by which light alone (as such) can be made to produce mechanical motion so as to mark a point upon a scale or in any way to give a correct reading off of its intensity or quantity at any moment. This obliges us to refer all our estimations of the degrees of brightness at once to our organs of vision, and to judge of their amount by the impression they produce immediately on our sense of sight. But the eye, though sensible to an astonishing range of different degrees of illumination, is (partly on that very account) but little capable of judging of their relative strength, or even of recognising their identity when presented at intervals of time, especially at distant intervals. In this manner the judgment of the eye is as little to be depended on for a measure of light, as that of the hand would be for the weight of a body casually presented. This uncertainty, too, is increased by the nature of the organ itself, which is in a constant state of fluctuation: the opening of the pupil which admits the light continually expanding and contracting by the stimulus of the light itself, and the sensibility of the nerves which feel the impression varying at every instant.

But yet more, when two unequally illuminated objects (surfaces of white paper, for instance) are presented at once to the sight, though we pronounce immediately on the existence of a difference, and see that one is brighter than the other, we are quite unable to say what is the proportion between them. Illuminate half a sheet of paper by the light of one candle, and the other half by that of several, the difference will be evident. But if ten different persons are desired, from their appearance only, to guess at the number of candles shining on each, the probability is that no two will agree. Nay, even the same person, at different times, will form different judgments. This throws additional difficulty in the way of photometrical estimations, and would seem to render this one of the most delicate and difficult departments of optics.

Now, with due deference to the reason assigned by this eminent philosopher for the eyes' inability to recognise different degrees of illumination, one of which, by the way, constitutes in itself an important item of its efficiency in this direction—*e g.*, "*the continual expansion of the pupil by the stimulus of the light*," we remark that that part of the eye which is exclusively engaged in recognising these illuminations, and measuring them, so to speak, from morning till evening, all the year round, was entirely ignored in his speculations. Vision, be it observed, is performed by the combined agency of two distinct sets of stimuli, the one to superintend and control the brilliancy of the light which enters the eye, the other to assist in utilising the light thus provided; the former is a reflex or instinctive act; the latter a voluntary one. Now, although by this last we become cognisant of the general effects of lights of different brilliancies—such as a bright day as opposed to a dull one, or the dim twilight as compared with the intense light of midday—we cannot by any voluntary act judge of minute differences or transitions in these intensities, any more than we can by the same voluntary act judge of the measure of an inch in length. These operations of judgment and exertion are so various that they cannot be relied on. It is at this crisis that the pupil interposes, and furnishes, by its instinctive powers, just that information as to the light's intensity which it was impossible to obtain by any voluntary effort of our own.

When the light falls upon the eye, therefore, the pupil instinctively assumes a given magnitude, which is always the same in the same person, under the stimulus of a light of the same intensity. Over this magnitude we are conscious of exercising no voluntary control.

We may conclude, in brief, that the pupil measures the light for the retina, the retina uses that light for vision, and we should have experienced the same difficulty with Sir John Herschel, in judging of the relative strength of different lights, if we had chosen, as he did, the retina with the mere exercise of its voluntary power, to the exclusion of an instinctive pupil, by which alone the feat can be accomplished.

* * * * * *

[Here in the MS. appears a description and illustration of Mr. Gorham's instrument. Inasmuch, however, as this follows closely on the lines of our own article on p. 465 of the last volume of Knowledge, the reader is requested at this point to turn back and reperuse the account of the Pupil Photometer which we there gave.—Ed]

(To be continued.)

SLATE IN AMERICA.

FEW people have any idea of the magnitude of the slate industry in this country. Until a few years since, the product of the different slate quarries in the United States was quite limited. Now the total amount produced, of roofing-slate alone, is about 500,000 squares a year. A "square" is 100 square feet, or sufficient to cover a space of 10 ft by 10 ft, when laid on the roof. It covers the same area as 1,000 shingles, and sells for from 3·50 dols. to 4·50 dols. per square.

As a roofing material slate is becoming more generally used, as it lasts a lifetime, is fire-proof, needs no painting, and renders rain-water pure and untainted. Besides the

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large amount of roofing-slate produced, a great deal is used for other building purposes, such as window-sills, steps, floors, and mantels. Billiard-table beds are now made exclusively of slate, and it is also used largely for flagging.

Most of the quarries are in eastern Pennsylvania—in Northampton and Lehigh counties. More than one-half of the total product of the United States comes from that region. Maine and Vermont produce small quantities. There are also small beds of slate in Michigan and Virginia. The quarries at Bangor, Pa., in Northampton County, are considered superior to any, as the slate is tough, durable, and of an unfading dark, blue-black colour. The quarries there are valued at from 50,000 dols. to 500,000 dols. each.

Over 3,000 men are employed in eastern Pennsylvania, and the number is fast increasing, as new quarries are opened and developed. The workmen are mostly Welsh and English. They earn good wages, have comfortable homes, and are a happy, sober, and industrious class.

The slate is first blasted out, then hoisted by steam-power in large irregular-shaped blocks to the bank. These blocks are then broken or "scalloped" into smaller blocks; then split into sheets of required thickness. For that purpose, a chisel or knife, about 18 in. long, resembling a large putty-knife, is used. The slate splits readily, whenever the knife is put in, if inserted when the block is wet, or "green," as it is called.

The workmen speak of the original moisture in the slate as "sap." After the blocks are dry, they harden and cannot be split.

After the blocks are split, the sheets are dressed or trimmed with a machine worked by foot-power to the required size, which is from 6 in. by 12 in. to 14 in. by 24 in. They are then shipped to all parts of the Union and to the Old World. A great deal of slate goes to Australia.

When beds are found, the slate is in inexhaustible quantities, and improves in quality as the depth of the quarry increases.—*No. Chatauqua News.*

The death is announced of B. B. Hotchkiss, the inventor of the world-famous Hotchkiss machine-gun.

Production of Copper in the States.—Official statistics show that the total production of copper in the United States last year was about 150,000,000 lb., against 115,500,000 lb. in 1883, an increase of 30 per cent. The gain was largest in Montana, that territory having turned out 44,500,000 lb. against 24,000,000 lb. in 1883. The increase in the Lake Superior region was 8,800,000 lb., and the Arizona 2,700,000 lb.

Sixpenny Telegrams.—In the House of Commons on Monday, Mr. S. Lefevre brought in a Bill to amend the Telegraph Acts, 1863 to 1878. He said that it was now arranged that the new tariff should come into effect on Aug. 1 next. The telegraph service had not improved, but very much the reverse, since 1881, as since that year there had been a reduction in the profit of nearly £200,000. The present tariff led to unnecessary and superfluous work, because under the Telegraph Act of 1868 the address must be sent free. The number of messages now sent by the telegraphic service was 24,000,000, the average receipt of each message was one shilling and a penny, while the average cost of each message was tenpence. If the Government gave for sixpence what they now gave for a shilling, that would entail a loss to the department of £650,000 a year. He had, therefore, come to the conclusion that the best tariff both for the public and the department would be one giving twelve words for sixpence and a penny for each additional two words, and that this should include the words in the address. The free address would, in fact, be abolished. The tariff, therefore, would be a word rate of two words for a penny, at a minimum charge of sixpence. He estimated that the addresses would average five words, which would leave seven words for the message. He believed that the receipts would be reduced from 1s. 1d. to 10d. per message, and that the average cost would be reduced from 10d. to 8¼d. He estimated that this reduction would cost £180,000 a year, and that the actual profit would not be more than £250,000.

Editorial Gossip.

Of all the survivals of monkish superstition and mediæval folly extant, the shifting about of the Festival of Easter in the Calendar is one of the most senseless and indefensible. Either the momentous event it is intended to commemorate actually occurred—or it did not. If it did not, there is no reason why an arbitrary date should not be fixed to celebrate what is typified. On the other hand, if (as is believed by an overwhelming majority of Christians) that event did actually occur, it must have happened at some specified date, which there should be no insuperable difficulty in recovering. Under existing circumstances Easter Day may fall on March 22 (as it did in 1818), or on divers intermediate dates between that and April 25 (as it will do next year). Five minutes' consideration of the way in which it is fixed will suffice to show how needless this is. Our present mode of determining Easter Day dates from A.D. 325, when the Council of Nice decided that it was "to be kept on the Sunday which falls next after the first Full Moon following March 20," *i.e.*, the date of the Vernal Equinox. Now, any person possessing merely ordinary common sense might imagine from this that he had nothing to do but to look at the Almanac for the first Full Moon sequent on the Sun entering ♈, to find that the Sunday following that must be Easter Day. Oh, dear, no! Pope Hilarius in A.D. 463 took care that no such obvious interpretation as this should be placed upon the rule. That "infallible" potentate decreed that the Paschal Moon should be the fourteenth day of the Moon by "the Metonic Cycle." I may perhaps just add here that this Cycle was discovered by Meton, at Athens, B.C. 432, and consists of 235 Lunations (or periods from Full Moon to Full Moon again). 235 Lunations occupy 6,939·69 days, an interval so very close to 19 years of 365¼ days each that 322 years must elapse before the Cycle gets a whole day wrong. But quite evidently in 19 years there may be either four or five leap-years whence a day's difference may arise: hence the real Cycle is 4 times 19, or 76 years long.

But practically we may say that the Full Moon falls on the same days of the same months every 19 years. Hence it will be seen that there are only 19 out of the 30 days subsequently to March 20 on which the Equinoctial Moon can be Full, and the "Golden Number" in the Prayer-book indicates that the day against which such number is placed is the day of Full Moon next before Easter Sunday. Moreover this Paschal Moon is not the real Full Moon, but, as I have previously said, the 14th day in the Metonic Cycle, and as this does not exactly coincide with any number of years, the Ecclesiastical Moon and the real one may differ by a day or two, and Easter may be five weeks earlier—or later—than it would be if determined by the actual Moon we see in the sky. And even an appeal to the phases of our own Satellite would not help us much under certain circumstances; for suppose the (real) Moon to be Full at Greenwich two minutes after midnight on March 20, *i.e.*, in the very beginning of the morning of March 21, then, using this real Moon, March 22 would be Easter Sunday at Greenwich. But in Dublin the Moon would evidently be Full at 11h. 37m. p.m. on March 20, so that following this precept, the Irish Easter Day would not be celebrated until April 26! To which illustration of the hopeless muddle in which we are landed by any attempt to determine Easter from Lunar Phenomena, I would merely add the obvious inference that if we cannot and do not speedily make it a fixed

Festival, like Christmas, we must be grovelling very low indeed before the Fetish of Ecclesiastical tradition.

The Weldon and Winslow scandal is happily beginning to bear fruit, as I am gratified to see that a Bill to amend the Lunacy Laws, introduced by the Lord Chancellor, has been read for the first time in the House of Lords. There is no doubt that Lord Selborne's Bill will throw great difficulties in the way of those who have heretofore been enabled to deprive merely eccentric people of their liberty from motives of private interest; but I cannot help feeling that it is still too tender towards the *fons et origo* of all the evils so perpetrated—I mean private asylums. Sooner or later public opinion will demand their entire abolition.

The presentation of the Albert Medal to that most gallant ornament to our police force, Sergeant Cole, on the 26th ult., must commend itself to the approbation of every Englishman. No deed on record performed during the heat and excitement of action has, or could have, exhibited truer courage of the very highest order than the picking up in cold blood of that mass of dynamite, with its burning fuse, in Westminster Hall, and carrying it to a spot where its deathly mission would be most likely to fail, and its violence expend itself with the smallest chance of mischief.

When I read that the sale of horseflesh as beef has become so extensive in Manchester as to necessitate an inquiry by the Local Government Board, I am tempted to thank my stars that my own lines have fallen in somewhat pleasanter places. Not that there is any reason *à priori* why the flesh of so eminently clean-feeding an animal as the horse should not be as sapid and nourishing as that of the ox; but then one would like it ticketed as what it really is. For aught I know a steak off the winner of the Derby might not suffer by comparison with one cut from the Christmas bullock immolated by Mr. Giblett for the Royal table; but I should like the vendor to be candid on the subject of its origin. The impecunious Frenchman who, praising our English fare, exclaimed: "Your Angleesh meat, he so var fin an' sheap, a man he bring von, too, tree piece on a leetle bit of stick for von penny, to my door every mornin'," was doubtless sincere, but we may reasonably suppose that he was ignorant whence the supply was derived.

Dickens said of theatrical "stars" that "they come out—and they go in again." Six or seven months ago we heard a great deal of the solution of the problem of aërial navigation by Captains Renard and Krebs, in France; but somehow they and their navigable balloon have gone from our gaze like a beautiful dream, as a venerable song hath it. Meanwhile I am delighted to see that that most Conservative of all conservative bodies, the War Office, has actually despatched balloons to the Soudan, and that as I write one is floating over the zarebah outside of Suakim. A more effective method of saving our handful of most gallant troops from an unseen and practically unassailable enemy could hardly be devised. This is applied science of a very commendable description indeed.

Erratum.—In the article on the Brighton Electric Railway, page 256, first column, line 35, for "20 lb. to the mile," read "20 lb. to the yard."

Reviews.

THE DESCENT OF MAMMALS.*

Professor Parker's eminence as a comparative anatomist, notably in craniology, led us to welcome with unusual interest the appearance of this work, the more so because the advertisements indicated that it was prepared especially for the enlightenment of general readers. The necessarily technical character of the Professor's contributions to the proceedings of learned societies renders them unsuitable for republication, while there is an ever-increasing class of inquirers who desire to know the best and latest concerning the momentous questions discussed in this book, but to whom such knowledge must, to quote the subtitle of this Journal, be "exactly described" and "plainly worded." Professor Parker may be relied upon to supply the exact description, but in the matter of plain wording his book is a bewildering disappointment.

The story to be told, namely, the changes which by natural selection and more obscure causes have developed the higher mammalia from the lower, is one so profoundly interesting, so captivating to the imagination, as well as bracing to the intellect, that it is with the bitterest regret we have to speak adversely of the manner in which it is told by so well-equipped an authority as the Hunterian Professor.

The plan of the book, which is due to Miss Buckley, the accomplished authoress of "Life and Her Children," and other works, is excellent, and the table of contents is set forth in crisp, bright English, which can have flowed only from her facile pen, and which makes us regret that the Professor did not hand over the rough materials of the chapters, excluding the puerile quotations from various sources, for Miss Buckley to present in a tongue "understanded of the people."

The confused and discursive paragraphs comprising the Introduction are followed by a chapter treating of the Prototheria or Monotremes, the lowest mammalian forms extant. They are so called because they have only one common sac into which the intestines and the ducts leading from the kidneys and generative organs all open. Although teatless, they have udders or milk-glands. Only two typical forms are known, and both these—the ornithorhynchus, or duck-billed water-mole, and the echidna, or spiny ant-eater—occur in the Australian continent, which, from its early physical isolation, has most preserved the lower mammalian forms. It will be remembered that, during the meeting of the British Association, at Montreal, last autumn, a telegram was received from Sydney announcing that Mr. Caldwell had discovered the Monotremes to be "oviparous with mesoblastic ovum," which, being interpreted, means that these intermediate creatures lay eggs, as do reptiles and birds, and that their eggs contain not only the pure protoplasm out of which the future offspring is formed, but also a store of food-yelk, by the absorption of which it is nourished during the early stages of development. The Monotremes, therefore, stand between the Sauropsida, or lizard-like animals, and the Marsupials, or pouched animals, as the kangaroo and opossum, the young of which are brought forth in an imperfect condition, as distinguished from the young of the placental mammals, which are born fully developed. Mr. Caldwell's discovery, therefore, points to the ancestry of man—the highest

* "On Mammalian Descent: The Hunterian Lectures for 1884." By W. Kitchen Parker, F.R.S. (London: Chas. Griffin & Co., 1885.)

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mammal—as reptilian, instead of amphibian, as has been thought heretofore, and it is to be regretted that Professor Parker, whose lectures were delivered in February last year, has not added to them some discussion in detail on the significance of this new evidence.

The chapters following treat in sequence of the several orders of mammals, of the Edentata or toothless animals, as the sloth, tapir, &c.; of the Insectivora, as the mole, hedgehog, and other insect-feeders; and of the higher mammals to man himself, whose lateral instead of lineal descent from the more important members, as the carnivora, is pointed out. Concerning all which matters the information is accurate and complete, but, as already hinted, conveyed in terms of which the telegram quoted above may be taken as a sample. When we read that "the scapula in the Prototheria does not give off a small coracoidal snag or beak;" that the "coracoid is continued from it to the sternum as a large, flat bone, and the forepart of the crescentic base of the whole plate is ossified as a separate epicoracoid;" that in the bird the "zygomatic process is a mere snag for muscular attachment, for it has no glenoidal cavity or cartilagineous facet;" that, "in us, as is well known, the internal pterygoid plates develop a retral hook, the hannular (hooked) process;" that "the pollex is deficient in *Rhynchocyon* and one species of *Oryzorictes*, and the hallux in *Macroscelides tetradactylus*," we exclaim with the eunuch in reply to Philip, "How can I understand, except some man should guide me?"

The concluding chapter comprises a series of general reflections, in which the theological bias of the author, although obvious, is never obtrusive, making the more welcome and significant his unstinted praise of Darwin, and his acceptance of the theory of organic evolution propounded by that great master.

We shall be sorry if any adverse criticism of ours should deter the reader from grappling with this book, and in justice to its author, since we have quoted him at his worst, we will quote him at his best from one of the Addenda which occur between each Lecture. Speaking of the skeleton of a seal caught at Stamford in 1846, and then of the mermaid myth associated with those creatures, the Professor says:—

> This bewitchment theory of the cause of the poor Moon-calf's shape, and enforced watery life, is borne out by his structure in the most remarkable manner; many worse and more absurd scientific theories than that have been hatched in human brains. Now, this is what I learned of the conformity of the structure of this creature with that of man—namely, that it would be possible for an accomplished anatomist to write an accurate account, using somewhat general terms, but naming every muscle, bone, nerve, artery, and vein—every sense-organ, and every one of the soft viscera within its body—and that description might be made to serve both for the seal and for man. More than this—far more; the same supposed biologist might take up the embryology of the seal, tracing the confluence of the two primary germ-points, their mutual engrafting, the growth of the foundations of the embryo (the "blastoderm"), then the differentiation of the various tissues and organs—and this second piece of descriptive anatomy might serve equally well both for the seal and for man. Then, if the physiologist took up the subject, the functions of every part would be found to correspond, and the physiology of a seal would be seen to be essentially the same as the physiology of our own more favoured type.
>
> I do not ask the reader to go through all the details and experiments for himself; but he might waste an hour in a less pleasing and profitable manner than by comparing the seal's skeleton with that of his own species in that model museum in Lincoln's-inn-fields. Then he would see in the skull, the spine, the chest, and the limbs, part for part, joint for joint, bone for bone, the same structure, but just gently altered, for somewhat different functions; altered as if by the hand—not of a demon of the deep, but by a kindly fairy—so little difference is there in the details of the skeletons of two creatures so diverse as a man and a seal (pp. 224-5).

SOME BOOKS ON OUR TABLE.

New Explanatory Readers, 1st and 2nd Primers, and Vols. I. to VI. (London: Moffatt & Paige.)—This is a carefully-edited and well-selected series of reading-books adapted to the successive standards one to six of the Education Department. The later volumes particularly seem not only adapted to instruct, but also to interest and amuse those for whom they are intended.

Sell's Dictionary of the World's Press for 1885. (London: H. Sell.)—Issued primarily as a guide to advertisers, this astonishing volume contains a mass of information as to the titles, characteristics, prices, and places of publication of practically every newspaper, journal, magazine, or periodical that is published in the civilised world. On its value to business men it would be idle to insist; but it addresses even a larger public than they constitute, large as that is. Every one who has occasion to trace a quotation from the periodical press to its original source will find it in Mr. Sell's book, where the paper is to be obtained, and how much it costs. The almost nominal cost of this big octavo volume places it within the reach of everybody interested in the subject with which it so exhaustively deals.

Injurious Positions to be Avoided during the Time of Education and Growth. By Mathias Roth, M.D. (London: Baillière, Tindall, & Cox.)—This excellent chart of positions to be avoided, as tending to produce spinal curvature, should be hung up for the information of mothers, nurses, teachers, and of boys and girls themselves, in every nursery and school-room in the kingdom.

Forewarned. By E. M. Abdy-Williams. (London: W. Swan Sonnenschein & Co. 1885).—The chief merit this sensational story possesses is that of being briefly told, and not spun out into three long, dreary volumes. It is the professed autobiography of a girl who marries a member of a secret society by special licence, and by night; and overhearing her husband's disclosure in his sleep of his intention to murder a foreign prince, comes herself under the sentence of death pronounced by the society against all who penetrate its secrets and refuse to join it. The terrible *dénouement* must be sought in the little book itself. Secret societies have been rather worked out by novelists lately.

We have also on our table the catalogues of Mr. E. Stanford and of Messrs. Moffatt & Paige. From Messrs. Cassell & Co., *Our Own Country* (as interesting and picturesque as ever), *Cassell's Popular Gardening*, *Cassell's Household Guide*, *The Book of Health* (with the continuation of the important papers on Education from a Hygienic point of view), *The Countries of the World*, *European Butterflies and Moths*, and *The Library of English Literature*. Also *The Sidereal Messenger*, *The Kansas City Review*, *The Medical Press and Circular*, *Wheeling*, *Le Franklin*, *Bradstreet's*, *Naturen*, *The Season*, *The Journal of the Society of Arts*, and *The Unity of Matter* and *Water and the Atomic Weights of the Chemical Elements*, by Mr. G. T. Carruthers.

MR. REMUS CROWLEY, THE CULTURED CHIMPANZEE.*

During the winter the most of the animals of the Central Park Menagerie are carefully housed, only a few of which are accustomed to cold winters remain where they are seen in the summer. The chimpanzee, Remus Crowley, Esq., occupies a cage in the office of Superintendent Conklin. A temperature between

* From the *New York Tribune*.

sixty and seventy degrees is maintained at all times, and the animal is as carefully protected from all draughts as an invalid person. In his native climate of Liberia cold draughts are unknown, and when exposed to them Mr. Crowley pays the penalty with a sore-throat or a cold in the head. At night a heavy blanket is placed in his cage, and when the weather is extremely cold he wraps himself up in it, but at other times uses it as a mattress. "Jake," a robust Park official, attends to him regularly, and the strongest attachment exists between them.

In personal appearance, Mr. Crowley has nothing delicate about him. He came to Central Park last June, and has now entered on his third year, growing rapidly and gaining over a pound a month; if he lives several years longer, he will probably attain a height of five feet. At present he is a trifle over two feet high and weighs twenty-six pounds. His hair is parted in the middle, and banged on his forehead; his body is covered heavily with hair and has no tail. When he stands upright, Mr. Crowley presents fully as civilised an appearance as the man in a heavy fur coat who crowds himself in a narrow place in the street car. His hands are shrivelled and brown, but his nails are delicately tinted and well-shaped, though evidently not looked after by a manicure, and his feet have characteristics resembling those in human feet, except that they are more flexible, and he uses them as readily as he does his hands.

"Jake," said Mr. Conklin, "we will have lunch, if it is Mr. Crowley's time." "Jake" placed some bananas on a low table, and then a plate, cup and saucer, and knife and fork. After setting out an infant's chair with a cushion in it, he led by the hand the chimpanzee, who had been watching him with apparent satisfaction. Mr. Crowley sprang quickly into the chair, and waited patiently while "Jake" pushed him up to the table, and placed a pink shawl on his shoulder.

"Will you have a banana, old boy?" asked "Jake."

Mr. Crowley passed over his plate, and received one that had been peeled for him. He picked up his knife and fork carefully, and cut a large piece from the fruit and transferred it on the fork to his mouth.

"Too much," said "Jake," disapprovingly; "don't be greedy Crowley."

Mr. Crowley cut the slices of the fruit into smaller pieces, and ate them deliberately. When "Jake" proposed a glass of milk, he nodded his head with a pleased grin, sipped the milk with a teaspoon, and then, lifting the cup to his mouth, drank a portion of it. His napkin is embroidered with the name "Remus Crowley," and after drinking, the chimpanzee wiped his broad mouth and chin with it fastidiously. But, having finished his meal, he held out his plate for more, and when refused, protruded his lower lip and cried disconsolately. Then he shook hands with the visitors, examined their finger-rings and pockets curiously, and when returned to his cage with reluctance, made faces at all present, and occasionally threw a handful of sawdust at them, and danced boisterously.

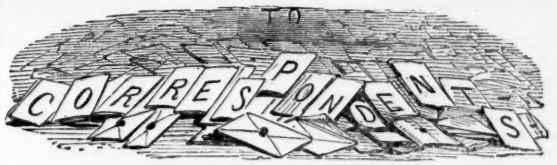
"He is good-natured, and as playful as a child," said Mr. Conklin, "not malicious, but full of mischief, and understands everything that goes on around him. In fact, he often reminds me of a deaf and dumb child, or an idiot."

"Does he make any sound indicating speech?"

"No; he utters peculiar cries, and moves his lips at times as a person would in talking. He shows clearly the different emotions of anger, pain, and grief; sulks when offended, and laughs when pleased. My belief in evolution has increased since I have had him under my care. I have seen many human beings less intelligent, and I believe that with careful selection for breeding there is strong possibility that the race might be developed and taught to speak. It certainly would be an interesting experiment, and would probably require several generations."

"Are there any other chimpanzees in the country?"

"There is a female in Philadelphia, but she has not received the attention which has been given Mr. Crowley, and she sits sulkily and silent all day long. They are fierce and strong, and live forty years in their native climate, but have always died after a few years when taken to other countries. We have been afraid that Crowley would get a cold that would result in pneumonia, but so far he has done well, and we hope now that he may be acclimatized. If both of them continue to thrive, possibly we may be able to bring about an engagement, and ultimately a wedding, between Mr. Crowley and the young woman in Philadelphia. I don't think there would be anybody to forbid the banns if both parties were willing. Crowley is fond of company, and does not like to be left alone. He amuses himself by swinging and practising all sorts of athletic exercises that would make a gymnast envy his agility and strength. We give him several ten-pin balls at times, and he never tires of rolling them and making a terrible clatter. Recently, a party of gentlemen met in my office to organise a Forestry Society. Crowley was immensely taken with the idea, and loudly applauded every speech."



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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THE DOCTRINE OF EVOLUTION.

[1654]—Sir John Lubbock's statement I commend to the Darwinians:—"The forms of leaves do not depend on any inheritant tendency, but to (*sic*) the structure and organism, the habits and requirements of the plant." Exactly, and to these *requirements* I would attribute, *e.g.*, the eye and teeth (beauty as well as use), and not to selection, natural or sexual. Take the case of teeth: they *must* be to eat; they must be of *bone*, for hardness. Thus we have use and beauty, beauty, indeed, being the *sine quâ non* of use, as, *e.g.*, in the case of clouds and flowers. But the case of the governor nerves is most striking. Utterly improbable that selection (*id est*, the seizing on of haphazard variation) could have caused the marvellous contrivance of the nerves from the right brain passing through the subtle foramen (?), to the *left* side of the body, and the nerves from the right brain, *vice versâ*, intercrossing. Believe me, there is more in heaven and earth than is dreamt of in Selection Philosophy! It is "the Cause, the Cause, my soul"—whatever that Cause may be. Commentator.

P.S.—Shakespeare and Handel were exceptions to the "rule" that men of genius are little; though, where they are so, the explanation is probably Compensation—small body, big brain; yet the exceptions throw doubt on this. Were Newton and Darwin little men?

LEFT-HANDEDNESS.

[1655]—In your article on "Our Two Brains," in No. 177 of Knowledge, you state that Dr. Brown Sequard "points out that very few left-handed persons have learned to write with the left hand, and those who can . . . . do not write nearly so well with it as with the right." I knew an army surgeon who had lost his right hand, and he wrote very easily with his left, but then he sloped his letters in the opposite direction to what we do—namely, from left to right. I had once the care of a little boy born without a right arm, and I taught him to slope his letters in this way—that is, from left to right—and he was getting on very well, but his mother objected to this style of writing, and so it was stopped. The reason why persons do not write so well with their left hand is on this account: That in writing with the left hand the whole direction should be reversed in order to bring it into conformity with right-hand caligraphy—viz., they should begin their lines on the right side of the page, writing from right to left, and slope their letters from left to right. In this manner, I think, the writing with the left would be quite as easy as with the right; but, of course, this is inadmissible, and they do not do it. At the same time, should my statement prove true, if would show that the powers of the two brains are equal so far as these relate to right and left-handedness.

J. E. S.

VIVISECTION.

[1656]—In your second paragraph of "Editorial Gossip," at p. 243, you are, I think, a little unfair to those who oppose cruelty to animals in the shape of unlimited physiological research. Those who support it, whether by magazine articles or otherwise, invariably shirk the real point of the matter, and speak of vivisection as if it really was—as you put it—"merely a matter of the temporary suffering" of half-a-dozen rabbits or guinea-pigs, and that with every precaution as to anæsthetics. If this was the simple truth,

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there would be very little of that opposition which now exists. There are unreasonable people among the anti-vivisectionists, but their number would be very small indeed was it not known beyond a doubt that a great many physiologists in this country would, were they granted an inch, be only too ready to take an ell.

I will do the non-professional supporters of these men the justice of saying that I am certain that few, very few, of them have the remotest conception of what this ell would be.

Boyd Moss, F.R.C.S.

[Will Mr. Moss kindly point out where, either on p. 243 or anywhere else, I have ever advocated "*unlimited* physiological research"? I am at least as much alive to the wickedness of the ghastly cruelties perpetrated by Schiff and others as he can possibly be; but *est modus in rebus*, and our correspondent must know full well, if he will only study 39 and 40 Vic., c. 77, with the slightest attention, that the repetition of such experiments as those by which certain Continental physiologists have disgraced themselves is impossible in England. To say, because enormities have taken place elsewhere, that hence English men of science shall be debarred from making physiological experiments altogether is to parody the teetotalers' argument, that because Mr. Sykes gets drunk and jumps with his hobnailed boots on the prostrate body of the unfortunate creature he lives with, hence I am never to take half-a-glass of sherry again as long as I live.—Ed.]

THE NAKED TRUTH.

[1657]—It seems singular there should be any dispute (letter 1645 *et ante*) respecting the power of men to live naked, not only in a temperate, but in a very inclement climate, in view of the testimony of our late great naturalist.

In his "Voyage of H.M.S. *Beagle* Round the World," page 213, edition 1870, Mr. Darwin, after describing the scanty garment of the central tribes of Fuegians—a small scrap, about the size of a pocket-handkerchief, hardly sufficient to cover the back so low down as the loins—continues:—"But these Fuegians in the canoe were quite naked, and even one full-grown woman was absolutely so." . . . . . "In another harbour, not far distant, a woman, who was suckling a recently-born child, came one day alongside the vessel, and remained there, out of mere curiosity, whilst the sleet fell and thawed on her naked bosom and on the skin of her naked baby."

At page 218, he gives an instance of four or five men suddenly appearing on the edge of a cliff "absolutely naked," their long hair streaming about their faces. On another occasion, a small family of Fuegians having joined his party round a blazing fire, he says:—"We were well clothed, and, though sitting close to the fire, were far from too warm; yet these naked savages, though further off, were observed, to our great surprise, to be streaming with perspiration, at undergoing such a roasting" (p. 220).

Cecil Duncombe.

SUNDIALS TO SHOW MEAN TIME.

[1658]—Old globes and maps of the world used to contain a graphic table of the equation of time, in the form of a curve called an "analemma," like a lengthy, slightly-leaning figure 8, touching with its larger bow the southern tropic, and with its smaller the northern. The two points where it crossed any parallel were distant from its main meridian by the sun's difference from clock time at the two moments of the year that his declination corresponds to that parallel. Thus, the whole curve represented the course of the sun's centre during a year, relatively to the imaginary *mean* sun's centre, or to one going round the ecliptic with uniform speed, or on one identical meridian mounting and returning from one tropic to the other and back.

Now, this figure might be projected on a cylinder, or Mercator's Chart, as well as a globe; and its degrees each way from the equator, instead of being equal, must then increase like a scale of tangents up to 23½°. The whole problem of making a dial show clock-time then resolves itself into making, as gnomons, two solids of revolution that can cast shadows whose outlines are each one-half of this 8-like figure, one to be used while days are lengthening, and the other while they are shortening. But each solid must have every part of its surface convex, and, as it has to receive the sun's rays not perpendicularly to its axis (except at the equinoxes), but inclined at all angles down to 66½° each way, the shadow to be taken into account is not one cast by the sun, but by a single luminous point, so near that the gnomon's length subtends 47° thereat.

We may take any meridian line through the 8-like curve (half of the 8) as the axis of the solid, provided it be not so far from the mid-breadth as to make part of one of the bulbs concave-necked (as it will be if the other bulb either vanish or be very small). It is, therefore, safest to choose such an axis as makes the two maxima of width, in the north and south bulbs, nearly or quite equal. As the meridian doing this will not be that on which the mean sun is supposed to remain, the XII. of the dial scale will not be at the true meridian, but shifted as much as we have shifted the line that we make the axis of our gnomon.

This makes my old suggestion of unshipping and changing the gnomon twice a year, on one identical dial, very inferior to that of having two dials separate.

Take first, then, that for lengthening days (I mean lengthening in the north, for our dial will do equally for either hemisphere). During the sun's north-coming, his time varies between 14m. 28s. behind clock, and 3m. 52s. before it. The mean of those is 5m. 18s. behind clock; and this equation occurs when his declination is 2° 51′ N. So, by shifting the scale of the dial 5m. 18s., we can have a gnomon whose bulbs are of equal width, but the waist 2° 51′ north of the equator.

For the other, during the sun's south-going, his time varies between 6m. 16s. behind clock, and 16m. 20s. before it. The mean of those is 5m. 2s. before it; and this occurs at nearly the same declination as the former, 2° 48′ N. Therefore, this gnomon will have its waist like the other, practically at 2° 50′ N., and hardly visibly differ from it, though both bulbs are slightly bolder. But this dial scale must be shifted 5m. 2s. the contrary way; so that the two dials will differ by 10m. 20s.

Taking from half the *Nautical Almanac*, p. 1, of each month, any number of declinations and the corresponding equations of time, you must add to each of these the corresponding "mean-time of sun's semi-diameter passing meridian." Then you have the ordinates for what I will call the *electric shadow-curve* of one gnomon, to be used from solstice to solstice. The corresponding abscissæ are the tangents of each declination. But you want the solid of revolution that will cast such a shadow, when illumined by a very small electric light of the brightest kind, so near that its length subtends 47° from that light. To make the section of this, you must take the *sines* of those same angles of which the shadow-curve had the *tangents*, and apply the same ordinates to each. Thus you see the curve of the gnomon itself, or of its *sun*-shadow, differs much from the old "analemma" curve, which is that of its *electric* shadow.

The width of the waist of each gnomon will correspond, on its dial scale, to the mean time of sun's whole diameter passing, when his declination is 2° 50′ N., which happens to be the least time that passage ever takes—namely, somewhat under 2m. 10s. By giving the waist this width, the black shadow will there exactly vanish, or its outline become a true figure of 8, the curve crossing itself. Now, you may ask, how are we to insure the use always of the right half of this figure, that is, on one half-year's dial the right-hand side of lower bow and left-hand side of upper, but on the other dial the right-hand side of upper bow, and left hand of lower? Nothing is easier. Attach to each bulbous swelling, on the side that must not be used, a tangential plane strip of thin metal indented like a comb or fringe. As no single dial is to be used longer than nine hours, the shadow of this fringe will always make one side of the gnomon's shadow plainly not the one to be noticed.

The "analemma," figure of 8, generally an *italic* one, was *upright* six centuries ago, when the difference of its bows was a maximum, and then one gnomon and dial would have done through the year. Some forty-six centuries hence that will again be the case, but the bows *equal* as well as upright. Their inequality is decreasing since the thirteenth century, but the *leaning*, that necessitates two dials, increasing for the next twenty centuries; then to decrease for some twenty-six, till they are both upright and equal, as fifty-eight centuries ago. E. L. G.

P.S.—I was wrong about the gnomon curve, which cannot be plotted, I fear, in any way. But something can be turned in a lathe, beside an electric light, till it casts the required shadow. The divergence must be just 47°. A sunbeam admitted through a lens that would serve for a telescopic eyeglass (either convex or concave), will do as well as an electric arc. The gnomon curve does not differ so much from its electric shadow as I thought, but is a "tough 'un" for mathematicians.

The gnomons are too thin-waisted to be made solid, but could be electrotyped hollow, and sustained by a strong wire stretched tightly through their axis.

ATWOOD'S MACHINE.

[1659]—Your correspondent "W. G. W." is wrong in supposing there to be any error in the expressions for f (the rate of increase per second in the velocity of the descending mass) given on page 58 of Williamson and Tarleton's "Dynamics." Supposing the moving mass constant, the acceleration varies as the pressure, or *statical*

force, which is required to produce it. The statical force of gravity is measured by weight, and it produces an acceleration g. If, then, F be another statical force which produces an acceleration f, we have

$$f = \frac{F}{W} \cdot g.$$

Now in Atwood's arrangement, W is the weight of the descending mass, but the whole statical force acting on it is $W - T$, where T is the tension of the cord.

Hence the acceleration, $f = \frac{W-T}{W} g$ . . . . . (1).

Again, if W' be the weight of the ascending mass,

$$f = \frac{T - W'}{W'} g,$$

equating the two values of f, we get

$$T = \frac{2 W W'}{W + W'},$$

which, substituted in equation (1), gives us

$$f = \frac{W - W'}{W + W'} g.$$

All this is carefully and clearly explained by the authors in question. J. R. CAMPBELL.

THE DRY-EARTH SYSTEM.

Christchurch District Drainage Board
(Engineer's Department),
Christchurch, New Zealand, Feb. 5, 1885.

[1660]—The article on "The International Health Exhibition," in KNOWLEDGE of Oct. 31 ult., would lead one to suppose its author recommended that excrementitious matter should be kept out of the sewers, and the ash-closet adopted, in the suburbs first, and eventually in the metropolis. I will, with your kind permission, say a word or two against such a proposal.

In small towns, sewers or no sewers *may* be a debatable question; but large centres *must*, if they wish to keep themselves in a decently healthy condition, be served by a system of sewers designed and constructed on proper and scientific principles.

I may state, in parenthesis, that it is only of comparatively late years the London sewers could be properly so designated, and, at the present time, I believe, many of the provincial English towns possess the luxury of the old-fashioned and nowadays universally condemned, sewers, which are not self-cleansing. Of such it is not my intention to speak further than to say that they are worse than useless, being little better than elongated cesspits.

In densely populated towns it is simply impossible to satisfactorily get rid of the ordinary household sewage without sewers; and, this being granted, it is the greatest mistake to exclude fæcal matter. It has been abundantly proved by the highest authorities in chemistry that the objectionable features, and even the chemical constituents of sewage are not appreciably altered by allowing the water-closets to be connected. Therefore, if we are to have sewers at all, let us make the most of them, and let them carry all sewage matter that will safely travel through them.

The dry earth system is an excellent one, where it is properly and systematically attended to; but I firmly believe, and am borne out in my opinion by men who have made the matter a special study, that this very rarely occurs, and then only in cases of isolated dwellings, where servants are specially told off for the purpose. At a moderate estimate it would take the enormous quantity of 2,000 tons of dry earth per diem to serve London and the suburbs, and I would ask how could such a quantity be regularly supplied, especially in winter; and, even were this objection overcome, who is to see that the earth is properly applied? Sifted ashes may certainly be made to do duty, but the supply would be quite inadequate, more particularly in summer, when they are most required.

The author referred to goes on to say that "it can be clearly shown they (the excrementitious matters) may be turned to profitable account." This is by no means borne out by facts, the result of such experiments being rather the other way; for I need scarcely say that the cost of removing the w.c. products of London by scavengers would be more than the ratepayers would care to incur; besides which, the demand for such products is extremely limited.

This city and district has recently been sewered on what is known as the separate system—*i.e.*, the rain-water is excluded; water-closets are being freely adopted; the sewers are regularly and systematically flushed; there is no symptom of any nuisance at the street ventilators, and the cost of disposal will shortly be covered by the sale of the produce from the sewage-farm.

In conclusion, I will only add that house-connections must be made on approved principles and under rigid inspection, and if this is done no danger need be apprehended.

EDWARD CUTHBERT, M. Inst. C.E.

LETTERS RECEIVED AND SHORT ANSWERS.

PUZZLED. Does it follow, because a thing "passes away," that hence it is annihilated? Your own letter has left *you* for ever and ever, but it lies before me as I write. Besides, the conservation of energy may be rigidly true in a mechanical sense, and yet, as far as usefulness or fitness for living creatures in concerned, a cosmical deterioration may be going on.—HOLMDALE. There is no "difference in the treatment of light from the sun and that from a fixed star." The sun we are regarding is the sun of eight and a-half minutes ago, whether he be on the horizon or at his nearest to the zenith. If we suppose our atmosphere to be annihilated (to get rid of the effect of refraction), the moment our horizon was interposed between us and the undulations of the æther impinging on it—*i.e.*, those which started from the sun eight and a-half minutes previously—he would disappear. The light waves would continue to arrive; but meanwhile the earth's rotation would be interposing more and more of her solid substance between our eyes and the source of those waves; in other words, raising the horizon higher and higher, or depressing the sun more and more. Quite obviously, when the earth has turned on her axis sufficiently to depress the eastern horizon of the observer below the wave-fronts of the light which left the sun eight and a-half minutes before he will seem to rise.—H. TRUEMAN WOOD. Received with thanks.—W. J. C. It is simply impossible to explain the question in a popular manner. Thirty years ago, Routledge & Co. published a little book on "Algebra and Plane Trigonometry," by Professor J. R. Young, in which, if you can get hold of it, you will find an effective trigonometrical demonstration that the decimals in π are interminable. Of course, the circumference is expressed with more than sufficient practical exactitude by a comparatively few decimals. To take your own proportion, 113 : 355, this will make your circumference some ·00000027 (twenty-seven hundred millionths!) too great, a quantity it might well puzzle you to measure in a circle sixty inches in diameter.—C. A. M. A few very elementary considerations will show you that your query is unanswerable. *Imprimis*, the distance of the nearest star in Hercules is, in the present state of our knowledge, immeasurable and practically infinite; and the components of that constellation—or many of them—may well be as far off again! Suppose, though, that we were moving at any given rate towards some star at a known distance, a division sum would enable us to find when we should reach it. For example, if the sun were travelling straight to Arcturus, of which the parallax is 0·13″, at the speed you specify, we should arrive there in 1,586,653 years.—THOMAS AYERS. It is the power of transmitting heat which was first called diathermancy by Melloni: diathermancy bearing the same relation to radiant heat that transparency does to light. I cannot conceive what you mean by "a heat-ray being reflected on itself." Such heat as is not transmitted is absorbed and converted into motion of the transmitting body—*i.e.*, it heats that body itself. You are under some delusion as to any "insult" having been intended. The gentleman to whom you refer is thousands of miles away, and has never set eyes upon one of your letters. Hence *his* memory was never appealed to at all.—E. L. G. No one appreciates your valuable *scientific* contributions to these pages better than I do, but you really must take your "sea" that "fell from the sky, about fifty centuries ago," to the Geological Society at Burlington House, for criticism by experts; because, merely as a matter of fact, it never fell on the spot whence I write.—T. S. CHRISTOPHER. Pardon me for pointing out that, in strictness, your question has no meaning, since the apparent passage of the sun from the north to the south of the equator has its origin merely in the tilting of the earth's axis 23° 27′ from a perpendicular to her orbit, the ecliptic. If, though, we suppose that the earth is fixed, and that the sun annually goes round her inside of a sphere whose radius = that of the earth's orbit, then would he be 37,803,500 miles north of the earth's equator (produced to such sphere) on June 21, and the same distance south on Dec. 21.—J. E. S. "Earthquakes" just *un trop peu tard*. The other, as you will see, inserted.—W. RUSSELL. Your "very bright star" is only the planet Saturn—that's all. See "The Face of the Sky," which appears here every fortnight. The only other planet fairly visible to the naked eye at present is Jupiter. You will find him just to the north-west of Regulus, *a* Leonis ("The Stars in their Seasons," Map IV.). I am unacquainted with any fuller list

of star names. Very few indeed of those given are now used.—ROBT. G. WHEELER. Received.—J. MURRAY. Of course, if *you* are "not satisfied with the modern system of astronomy, it is better to get another." This was the opinion of "Zadkiel," "Parallax," Mr. Gillespie, and hosts of others, and each has had his own "system." Why not? Britons never, never, never, &c., will be slaves, and why should we all be tied down to a theory upon which (for example) all the calculations for the *Nautical Almanac* are based? Your glorious independence of the fundamental principles of arithmetic is equally creditable to you as a free-born Scotchman. What, however, amazes me is, that with the extraordinary changes which you allege to be in progress in the earth's orbit, Dr. Hind should, year after year, continue to furnish such marvellously accurate predictions of eclipses and the like.—MANFRED J. CROSBIE. Delayed through having been addressed to the editor instead of the publishers.—E. C. H. As I have seen the Zodiacal light extending very nearly as far as the Pleiades, it may be traced by any one who knows what to look for until Aries is pretty near the horizon. It becomes visible in twilight, and when best seen looks like a blunt cone of white light with its axis nearly in the ecliptic. It is, just to say, brighter than the Milky Way. I have no doubt whatever that you have seen it.—BICYCLE. If you mean mechanically possible, of course it is. It is *not* "essential to its keeping up that it should describe one or more lateral curves." Want of rigid uniformity in pedalling may make it "wobble," but it would remain upright if properly balanced and propelled along a perfectly straight line.—N. You will scarcely do much with a rain-band spectroscope on a 3-inch telescope; and, notably, if the latter be not equatorially mounted; but by narrowing the slit and making it a tangent to the sun's limb, you may pick up the C and F bright hydrogen lines, and the D_3 "helium" one in the solar prominences. You may also see the Spectra of Sirius, *a* Orionis, *a* Herculis, &c., but very little more. Neison's "Moon," published by Longmans, contains the most detailed lunar map, in anything like a portable form, with which I am acquainted. You will find a very convenient one in Vol. III. of KNOWLEDGE. Our advertisement columns are always open to publishers who wish to make the prices of their books known. The solitary "place in London in which an amateur can pick up anything relating to astronomy" is at the Gresham Lectures, which are free to the public. They are announced from time to time as they are about to be delivered. As you, FACIEBAT, H. DU CROZ, and others all express a wish for a popular description of precession and nutation, I will request "F.R.A.S.," at his leisure, to prepare an article dealing familiarly with that subject.—FACIEBAT. In the absence of further details, it would be idle to speculate why Miss Martineau failed to see a comet which was visible to other people.—X. X. X. I know of no absolutely trustworthy one. Brewer's "Guide to Science" is the best. You could, by the way, answer your own three queries admirably out of Tomlinson's "Mechanics" in "Weale's Series."—C. ICHABOD WRIGHT. The first gentleman named has had a hint. The second is 4,000 miles off.—AUG. J. HARVEY. When the "phonetic language" is commonly taught in schools, and when the National Exchequer is so overflowing as to justify the Postmaster-General in giving us "penny telegraphs," you will, of course, lose no time in bringing your suggestion before the public. You should communicate with the Postmaster-General.—JOHN GORHAM. The paper has been up in type for some weeks now, and the first instalment will appear the instant I can find space for it. We are often very considerably in advance with our matter. It would be impossible to carry on a paper like KNOWLEDGE from hand to mouth. I repeatedly get letters on Mondays or Tuesdays asking for replies "in your next issue," when very probably the whole column of "Letters Received" has been made up for a day or two. I know that letters sometimes appear in the Correspondence Columns when I am afraid that their writers must have forgotten all about them.—A BREWER. The politico-economical relations between brewers and the Chancellor of the Exchequer rather outside the scope of a journal devoted to science.—AN OLD DRAUGHTSMAN. Received with thanks. Glad to welcome you here again.—COMMENTATOR. All that is definitely known about the spots seems to point to the conclusion that they are depressions in the photosphere and are cooler than the surrounding regions. You must excuse me, but I must and will, as far as in me lies, confine the contents of these columns to *Science*, and it is a prostitution of that word to apply it to such a subject. I no more feel called upon to "explain" the pseudo-miracles you enumerate than I do to give the *modus operandi* of the man who strokes two rabbits into one in the very midst of his audience. I have never expressed any opinion that Mr. Labouchere's incredulity is of a vulgar type. What I did say was that, having made a definite offer to pay a certain sum if (no matter how) a certain feat was performed, I failed to see how he could justify his conduct in not paying the money when that feat was accomplished. You can best answer your own question—or part of it—by first reading pp. 102 to 112, inclusive of Mr. Crookes's "Researches in the Phenomena of Spiritualism," and then turning to the *Times* newspaper of Jan. 11 (or 12), 1880, and studying the account, signed by Sir George Sitwell and Herr von Buch, of the way in which they detected Mrs. Florrie Corner (*née* Cook), alias Katie King, &c., *flagrante delicto*, in her paltry imposture. If, after this, you do not reply Yes! to your query, your ideas of evidence must be odd, to put it as euphemistically as possible. De Morgan, whom I knew, was a most brilliant mathematician, but very crazy and crotchety on other subjects. Your evolution letter marked for insertion.—G. T. CARRUTHERS. Should rather be submitted to the criticism of the Chemical Society.—W. THORNTON SHARP. He is not in England.—CHAS. E. MACBRIDE. As stated on more than one occasion here, the conductor of this Journal has been compelled to make an inexorable rule never to give his autograph.—DUNCAN FORBES. See reply above to Mr. Thornton Sharp.—B. MITCHELL. Delayed through being addressed to the Editor instead of the publishers.—TWO INQUIRERS INTO KNOWLEDGE. Premising that the change in the eccentricity of the earth's orbit is very slow (·000041 in 100 years), we cannot continue beyond 24,000 years, when it must attain its minimum of ·0033, and is, in fact, caused by the attractive influence of the other planets, and is confined within very narrow limits. I may proceed to say, my dear young ladies, that I fear that your cometic hypothesis will not, in vulgar parlance, "hold water." No reasonable doubt can exist that the whole of our solar system has had a common origin, and has in all probability been formed from a primal nebula. Moreover, as far as observation extends, it seems likely that all the *solid* matter in the biggest comet that has ever been seen by mortal eyes might well be packed in one of your own bonnet-boxes. Who told you that one part of space was hotter than another? The little book you quote is very charming, but it is no authority on the subject.

Miscellanea.

WILLIAM C. KINGSLEY, the originator and builder of the Brooklyn Bridge, died on February 21.

THE number of men employed on the Forth Bridge works is about 2,000, including the Italians engaged in the compressed air sinking arrangements.

IT has been definitely decided, says the *Athenæum*, to purchase two adjoining houses in Kensington-square for the accommodation of the ladies' department of King's College. A considerable sum will still have to be raised, and it is hoped the public may contribute warmly to support this effort to provide for the higher education of women. The entries this term are very good. The total number is 500.

IT is also proposed to establish a hall at Cardiff for the lady students attending the University College of South Wales. By this means a university training will be offered, it is hoped, to women at a cost of only £50 per annum; £10 being the sessional tuition fee, and £40 the boarding fee.

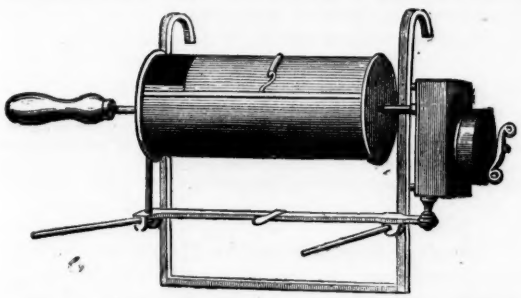
THE ALEXANDRA PALACE.—The International Exhibition at the Alexandra Palace, which has been in preparation for some time, was opened on Tuesday, the inaugural ceremony being performed by Lord George Hamilton, M.P. Since the building was closed a couple of years since there has been an entire renovation, and the whole place looks fresh and bright. As in the case of most shows of a similar kind, a great number of the exhibitors have delayed bringing up their wares until the last moment, with the result that everything is at present in an unfinished state. Mr. Levey, the executive commissioner, said that there were some two millions of persons to whom this Palace was more easy of access than either South Kensington or the Crystal Palace. In these days, when such efforts were being made to secure as many open spaces as possible around the Metropolis, the reserve of some two hundred acres of beautiful park in one of the most healthy parts of London was no mean desideratum. He asked to be allowed to allude to the undertaking by the administration to pay over one-tenth of the receipts for admission to a hospital committee for distribution among the leading hospitals of the metropolis. The Great Northern Railway Company announce that a frequent service of special and ordinary trains will be run between Moorgate-street, Broad-street, and King's-cross and Wood-green (Alexandra Park) Station and the Alexandra Palace Station. The last train will return from the Palace fifteen minutes after the advertised time of closing the Palace.

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE *being a popular magazine*) *than is accorded by the most excellent trade journals.*

COFFEE-ROASTING MACHINE.

THIS new coffee-roaster, by Messrs. Follows & Bates (Limited), of Manchester, is automatic in its action. It is also simple in construction and easy to manage, commending itself to every one desirous of making good coffee. It is a domestic machine, and intended to roast from half-a-pound to a pound of coffee at a time, which operation it performs perfectly in fifteen to twenty minutes, according to the heat applied. As will be seen by the illustration, the coffee is put inside a cylindrical drum, which is actuated by a simple piece of mechanism at one end, encased in a box and protected from dust, like an ordinary bottle-jack, but wound up by a fixed key. A rod passes through the drum, which answers a double purpose—by taking hold of the handle it may



be removed instantly from the fire to see if the coffee is roasted sufficiently without disturbing the hanger or the driving apparatus. At the other end of the rod there is a small socket, like that in a clock-key, which fits the spindle set in motion by the apparatus. Before roasting, all that is necessary is to wind up the machine once. Place the requisite quantity of green coffee-berries inside the drum, and then hang the whole machine before a bright fire. There are a couple of bars on which the drum rests, which admit of its being placed quite close to the fire, or at a distance from it. When the coffee assumes a bright brown colour (the sooner the better) it will be found to have acquired the flavour characteristic of the best roasted coffee.

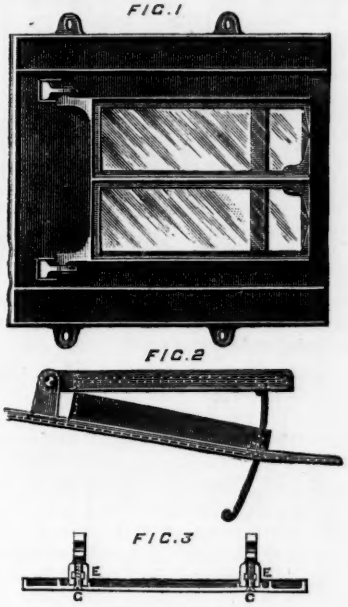
LETTER GRIP.

Messrs. Iles Bros., of Birmingham, have patented a form of letter-holder of a most efficient character. It consists of one or more spirals of nickel-plated steel wire, fixed at the ends, and laid

along a wooden base-board, or bent around a semi-circular piece of wood, as shown in the accompanying illustration. Letters and other odd papers to be retained for reference, letters awaiting to be posted, &c., are inserted between the coils. The advantages of such an addition to the library or office are apparent. It is simple, effective, cannot get out of order, and is at least as commendable as any other device with which we are acquainted.

IMPROVED SKYLIGHT.

[Patent No. 7,838. 1884.]—Skylights have hitherto been hinged so that the movable frame could be easily unscrewed from the outside, and access to the inside gained without any visible disturbance. The improvements introduced by Messrs. McDowall, Steven, & Co., of the Milton Ironworks, Glasgow, and shown by reference to the drawings, are that the unhinging is accessible only



from the underside of the frame, which is fixed securely to the roof. Fig. 1 is a plan, and Fig. 2 a side elevation, both representing the skylight as open. Fig. 3 is a transverse section of the fixed frame as taken through the lugs to which the movable frame is hinged. E E show how the lugs are fixed by the screws G G from the underside of the fixed frame. This new feature in skylights gives greater security than has been formerly attained.

CASEMENT STAY.

[Patent No. 9,877. 1884.]—This fastener, patented by Mr. A. Dowling, of Caroline-street, Birmingham, consists of an arm or stay pivoted to the movable casement-frame, and passing through a box pivoted to the fixed window-frame. A spring, with or without a small friction roller, is attached to the bottom of the box, and presses the arm upwards. This arm is provided with a number of notches on its upper side, one or other of which, under the influence of the spring, engage with a projection on the upper part of the box. By pressing the free end of the arm and sliding it to and fro in the box, the casement may be opened and closed, and by simply releasing the pressure, the nearest notch is engaged and the window fastened. If it should inadvertently be left unfastened by any one opening or closing the casement it will, with the least pressure of wind or otherwise, immediately lock itself.

THE Russian translation of "John Bull's Neighbour in her True Light," will be published in St. Petersburg some time in May next. A translation is also to be published shortly in Germany.

A FRENCH translation of "The Siege of London" is to be published in Paris before long. Messrs. Marpon & Flammarion will the publishers, and the first edition, we hear, is to consist of 50,000 copies.

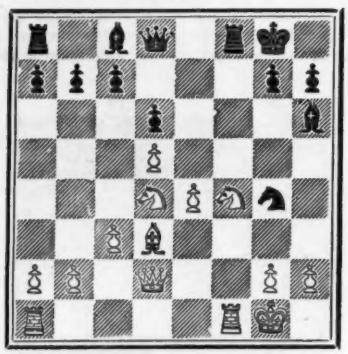
Our Chess Column.

By MEPHISTO.

ENDING of a game played recently in the City Chess Club. White receiving the odds of P and move.

J. GUNSBERG.

BLACK.



WHITE.

T. HEPPELL.

The game proceeded as follows:—

	Kt × P
15. K × Kt	Q to R5 (ch)
16. K to Kt sq.	B × Kt
17. Kt to B3	Q to R3
18. Q to K2	B to K6 (ch)
19. R to B2	B to Kt5
20. R to K sq.	B to Kt3
21. P to K5	B × Kt
22. P × B	Q to R5
23. B to K4	R to B5
24. Q to B2	Q to Kt6 (ch)
25. K to B sq.	R to R5
Resigns.	

WE publish the following lively little game without any comment, like "Lieder ohne Worte," it speaks for itself.

"BLACKMAR" GAMBIT.

White. Edw. Carter.	Black. Dr. Clark.
1. P to Q4	P to Q4
2. P to K4	P × P
3. P to KB3	P × P
4. Kt × P	B to Kt5
5. P to QB3	P to K3
6. B to Q3	Kt to KB3
7. Castles	B to Q3
8. Q to K sq.	Castles
9. Q to R4	B × Kt
10. R × B	P to KR3
11. QB × P	P × B
12. Q × P	Kt to Q2
13. Q to Kt5 (ch)	K to R sq.
14. R to R3 (ch)	Kt to R2
15. R × Kt mate	

SOLUTION.

PROBLEM No. 151, BY J. S. MCKEAN, p. 249.

Position: White K—QB sq. R—KB sq. B's—KB8, Q3. Kt's—QKt sq., K5. P's—KKt3, K4.
Black K—Q5. Kt's—QKt sq., KR7. P's—K3, QR5.

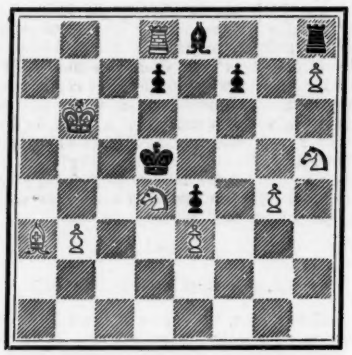
1. Kt to R3	K × Kt, or	1.	K to B6
2. Kt to Kt5	Kt to Q2	2. Kt to Kt5 (ch)	K to Kt6
3. B to Q6 (ch) mate		3. B to B4 (ch) mate	
2. or	Kt × R		
3. B to Kt7 (ch) mate.			

If Kt × R 2. Kt to Kt5 (ch) and B mates accordingly.

PROBLEM No. 152.

By J. S. MCKEAN.

BLACK.



WHITE.

White to play and mate in three moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

F. W. GRIFFIN.—We are not quite clear as to your meaning. When receiving odds of moves, a player cannot advance beyond the fourth square, or the middle of the board.

Correct solutions received from W., E. Smart, E. Louden.

ELECTRIC LIGHTING FOR MINES.—In some experiments carried out by the officers of the Regimental School in Versailles it was shown that the incandescent lamps used in the lighting of subterranean passages were capable of resisting the concussion caused by the explosion of 500 kilog. (1,100 lb.) of powder.

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NOTICES.

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